

BOSCH system : Electronically controlled diesel fuel injection (EDC = Electronic Diesel Control)

Make of vehicle : BMW

Basic microcard : PKW-083

These brief instructions, valid at the time of publication, apply to the following BMW model:

324 td
with electronically controlled diesel fuel injection (EDC = Electronic Diesel Control)

Engine: M 21 D 24 WA, 85 kW
EU, 09.87 ->

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Vehicle versions equipped for

- Austria
- Switzerland
- Sweden

are additionally equipped with an exhaust-gas recirculation system.

STRUCTURE, USAGE

These breif instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to various causes/component faults. Detailed instructions for trouble-shooting must be taken from the basic instructions via the trouble-shooting chart.

ATTENTION:
Even if reference is made to basic instructions, the set values, terminal assignments and special features of t h e s e vehicle-related brief instructions are a l w a y s binding.

SAFETY AND PRECAUTIONARY MEASURES

Be sure to observe these measures in order to avoid damage to the engine, control units and peripheral components of the EDC.

1. For testing the compression, disconnect the lead at the ELAB.
2. In the case of nozzle-holder assemblies with inductive start-of-injection sensor, the after-sales service workshop is permitted to perform only an adjustment of the nozzle-opening pressure.
3. Never start the engine when the battery is not firmly connected.
4. Do not use a fast charger for starting the engine.
Provide starting aid using only a second 12 V battery and jump leads.
5. Disconnect the battery from the vehicle electrical system before fast charging.
6. Never disconnect the battery from the vehicle electrical system while the engine is running.
7. Never disconnect or connect control-unit plugs when the ignition is switched on.
8. Remove the control units at temperatures exceeding + 80° C (paint-drying installation).
9. Remove the control units whenever welding (electric spot welding).

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Diagnostic lamp lights
2. Starting motor operates, but engine fails to start or starts only with difficulty (when warm or cold)
3. Engine hunts when idling
4. Rough idling when engine is warm
5. Fuel consumption high, maximum engine power not reached, and smoke formation
6. Unsatisfactory performance
7. Black smoke in full-load range, engine running rough; possibly lack of power
8. Engine running rough

						Cause (component fault)
*						Self-diagnosis/reading, water-level sensor
*						Voltage supply, control units
*						Delivery controller
*						Spool-travel sensor
*						ELAB
*			*	*	*	Computer monitoring
			*	*	*	Solenoid-op. valve (start of injection)
				*	*	Electropneumatic switch-over valve (EGR)
			*			Nozzle-holder assembly with needle-movement sensor (NBF)
			*			Computer interface
	*		*	*	*	Engine-speed sensor
*						Engine-speed sensor and NBF
*						Tank empty, tank ventilation
*	*		*			Injection sequence not firing sequence
	*					Inlet-union screw, fuel return
*	*					Air in fuel system
*						Paraffin separation
*		*				Fuel lines leaking
*						Supply lines clogged
*		*	*	*	*	Injection nozzle
*	*	*	*	*	*	Coord. pump - engine (injection timing)
*						Fuel filter
*						Pre-heating system
*	*	*	*			Engine compression
		*				Engine air filter
		*				Engine timing

TROUBLE-SHOOTING CHART (Continued)

Customer complaint (symptoms of trouble)

9. Engine misfiring during vehicle operation
10. Engine cuts out of its own accord
11. Engine running at constant engine speed
12. Engine will not rev up when cold
13. High idle and engine running rough at high engine speed
14. Black smoke in full-load range
15. Fog-like smoke in full-load range (white)

Cause (component fault)

	*				Accelerator-pedal sensor
*					Delivery controller
*		*			Spool-travel sensor
*					Computer monitoring
*					Engine-speed sensor and NBF
*	*	*		*	Tank empty, tank ventilation
*	*	*		*	Injection sequence not firing sequence
*		*		*	Inlet-union screw, fuel return
*		*		*	Air in fuel system
		*			Paraffin separation
*					Fuel lines leaking
*		*		*	Supply lines clogged
		*		*	Coordination, pump - eng. (injec. timing)
		*		*	Fuel filter
		*			Engine compression
	*				Safety switch, accelerator-pedal sensor
*					Fuel heater

TROUBLE-SHOOTING CHART (Continued)

Customer complaint (symptoms of trouble)

6. Severe bucking, no idle increase during vehicle operation (manually shifted transmission)
17. Faults are not stored by self-diagnosis
18. Exhaust-gas recirculation not operating
19. No low-idle-speed increase
20. Black smoke in full-load range, engine running rough; possibly lack of power
21. Unsatisfactory performance
22. Starting motor operates, but engine fails to start or starts only with difficulty (when warm or cold)

Cause (component fault)

	*				Computer monitoring
	*				Solenoid-op. valve (start of injection)
	*				Electropneumatic switch-over valve (EGR)
	*				Nozzle-holder assembly with NBF
*	*				Engine-speed sensor
*	*				Road-speed sensor
*					Switch, clutch or brake
	*				Temperature sensor (air)
	*				Temperature sensor (coolant)
		*			Switch, air conditioner
		*			Timing device
			*		Turbo-supercharger
			*		Charge-air pressure sensor
			*		Closed-loop charge-air-pressure control
			*		Fuel heater
		*			EGR valve

TROUBLE-SHOOTING

How to use the self-diagnosis

Trouble-shooting (testing) must always begin with self-diagnosis.

In position 2 of the key-operated switch, the diagnostic lamp lights up for approx. 5 seconds (lamp test).

If the diagnostic lamp does not light up after actuation of the key-operated switch, test the self-diagnosis.

Always note down the flashing-code output.

If the voltage supply for the control units is interrupted, the faults stored are cleared.

If a faulty operational path is indicated, pay particular attention to the following:

- * loose contacts at multiple cable connections
- * dirty, pushed-back or corroded plug contacts
- * breaks in lines at kinked or pinched locations.

Test instruction:

before disconnecting or connecting the control-unit plug, switch off the ignition.

SELF-DIAGNOSIS VIA FLASHING-CODE EVALUATION

An integrated self-diagnosis system makes it possible to locate a faulty component or line path via a flashing code. This is indicated in conjunction with the reading of the water-level sensor. The indicator lamp is positioned in the instrument panel.

The diagnostic program is activated by briefly connecting socket 15 (20-pin diagnostic plug) to ground, while also using the flashing-code evaluating unit KDAW 9980.

The flashing-code output begins with the fault which was stored first. The faults are output one after the other. The program returns to the beginning once the last fault has been output (annular slide valve).

Evaluating the flashing code

1. Switch on ignition.
2. Stimulation of the self-diagnosis must be for at least 4 seconds.
3. Flashing code is indicated.
4. Repeat stimulation:
 - a. if no further fault is present, the same fault is indicated again
 - b. if further faults are present, these are indicated with each repeated stimulation. If all faults stored have been output, the first fault present is indicated (annular slide valve).

Clearing the flashing code

1. Position key-operated switch to position 2.
2. Actuate brake pedal and at the same time, stimulate the self-diagnosis.
3. Call up self-diagnosis by repeating stimulation.
4. If the indicator lamp does not light, the fault memory has been cleared.

SELF-DIAGNOSIS TEST TABLE

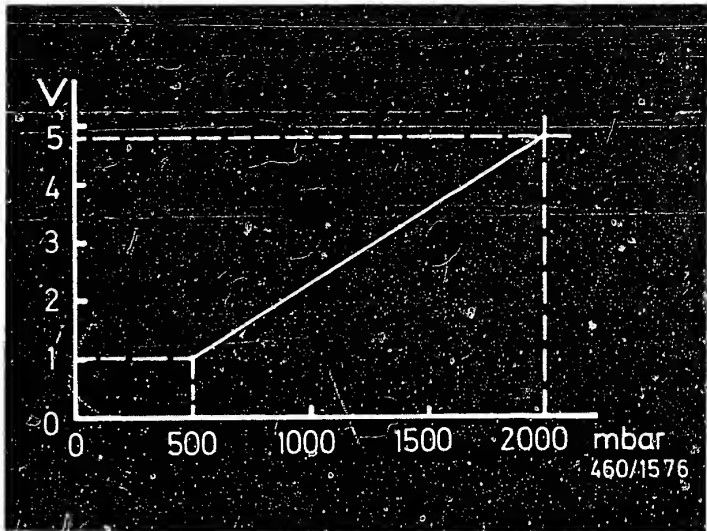
Fault indication Flashing code	Testing of component/function	Test instructions /Test conditions	Terminals	Set values
1	Temperature sensor (coolant)	Test resistance at component. +15...+30°C: Approx. 80°C: Test measuring voltage (control unit) at disconnected cable connector.		1300...3600 Ω 250...390 Ω approx. 5 V
2	Accelerator-pedal sensor	Conduct tests at component. * Internal resistance * Supply voltage * Voltage signal: -idle position -full-load position * Safety switch: -idle position -full-load position	 2 - 4 2 - 4 (+) (-) 1 - 4 1 - 4 2 - 5 2 - 5	 800...1400 Ω 4.5...5.5 V 0.23...0.50 V 2.79...5.0 V > 1 M Ω 600...1400 Ω
4	Temperature sensor (fuel)	Conduct tests at 7-pin cable connector of EDC distributor-type fuel-injection pump with aid of test adapter KDEP 1165 and adapter leads KDEP 1165/300 and -/301. * Short circuit to ground Connect adapter to cable connector to injection pump * Short circuit Connect adapter to cable connector to injection pump * Internal resistance at 15...30°C: (Connect adapter to cable connector to injection pump) * Measuring voltage (control unit): (Connect adapter to cable connector to control unit)	 5-grnd. 6-grnd. 4 - 6 5 - 6 5 - 6	 > 1 M Ω > 1 M Ω > 1 M Ω 1200...4000 Ω 4.5...5.5 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
5	Control unit, computer interface (stored)	Fault is not present at time of testing. Disconnect cable connector from control units 1 and 2. Afterwards, test the leads listed for open circuit and/or contact resistance: Control unit 1 Control unit 2 Term. 14 to term. 9 Term. 15 to term. 12		approx. 0 Ω
5	Control unit 1 Computer monitoring	Fault in computer monitoring is present only if the engine <u>cannot</u> be started after the flashing code indicated.		
(5)	Control unit 2 Computer monitoring	No reading via the indicator lamp after stimulation of self-diagnosis. Exhaust-gas recirculation switched off. Disconnect multiple butt connector from solenoid-operated valve (start off injection). Test measuring voltage (control unit) at multiple butt connector.		approx. 12 V
6	Temperature sensor (air)	Test resistance at component. 15...30° C: Approx. 80° C: Test measuring voltage (control unit) at disconnected cable connector.		1300...3600 Ω 250...390 Ω approx. 5 V
7	Road-speed sensor	Test requirement: correct speed indication. Test measuring voltage (instrument cluster) at disconnected engine plug. Test requirement: no speed indication Conduct operational test on component.	14(+) - (-)	>4.5 V 9 deflections of pointer/rotation of wheel

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/ function Test instructions/conditions	Termi- nals	Set values
8	Charge-air pressure sensor. Conduct test at component. * Supply voltage * Voltage signal (determine barometric pressure)	1 - 3 1 - 2	4.5...5.5 V see character- istic curve
9	Closed-loop charge-air-pressure control Conduct test at electropneumatic pressure transducer. * Internal resistance (0...120° C) * Test measuring voltage (control unit) at disconnected cable connector	1-grd.	4.5...8.0 Ω approx. 12 V
10	Delivery controller. Conduct test at 7-pin cable connector of EDC distributor-type fuel injection pump with aid of test adapter KDEP 1165 and the adapter leads KDEP 1165/300 and -/301. * Short circuit to ground Connect adapter to cable connector to injection pump * Internal resistance Connect adapter to cable connector to connector pump * Supply voltage Connect adapter to cable connector to control unit	4-grnd. 7-grnd. 4 -7 7-grnd.	> 1M Ω > 1M Ω 0.3...1.2 Ω 8.5...14.5 V

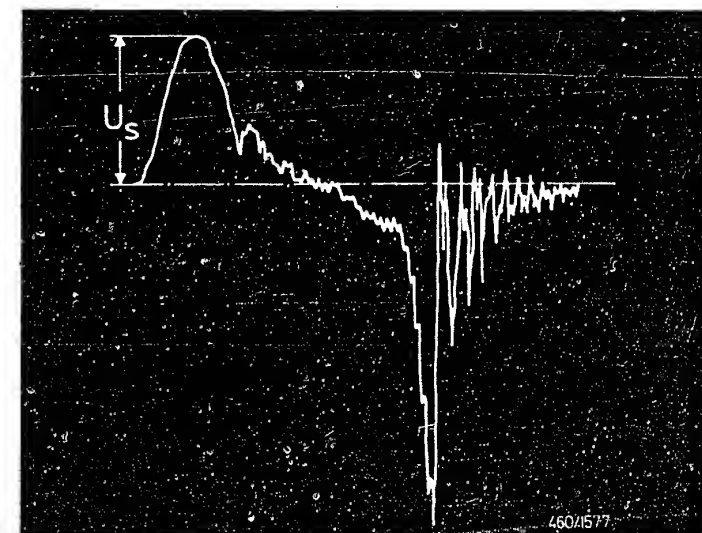


* * = serious fault (occurrence results in steady light of indicator lamp during op.)

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/ function Test instructions/conditions	Terminals	Set values
11	<p>Needle-movement sensor. Conduct test at cable connector of component.</p> <ul style="list-style-type: none"> * Short circuit to ground * Internal resistance approx. 20°C approx. 80°C * Supply voltage <ul style="list-style-type: none"> - cable connector disconnected - cable connector connected at approx. 80° C * Needle-stroke signal/signal voltage (U_s) <ul style="list-style-type: none"> - cable connector connected - run engine at idle speed - motortester, special input 		<p>> 1 M Ω</p> <p>90...110 Ω 111...135 Ω</p> <p>10.0...12.0 V 1.8... 8.8 V</p> <p>see signal pattern</p> <p>$U_s = > 150$ mV</p>

* * = serious fault (occurrence results in steady light of indicator lamp during op.)



SELF-DIAGNOSIS TEST TABLE (CONTINUED)

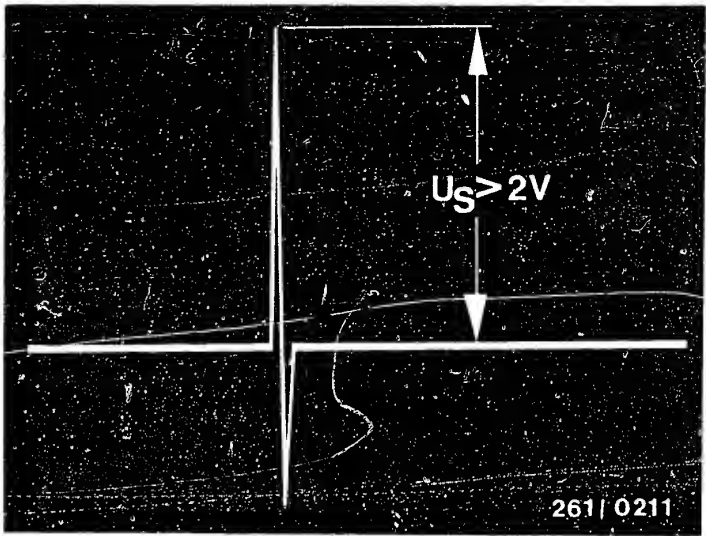
Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
12	Spool-travel sensor	<p>Conduct tests at 7-pin cable connector of EDC distributor-type fuel-injection pump with aid of test adapter KDEP 1165 and adapter leads KDEP 1165/300 and -/301</p> <p>* Short circuit to ground Connect adapter to cable connector to injec. pump</p> <p>* Short circuit Connect adapter to cable connector to injec. pump</p> <p>* Resistance, potentiometer path Connect adapter to cable connector to injec. pump.</p> <p>* Resistance, wiper path Connect adapter to cable connector to injec. pump.</p> <p>* Supply voltage Connect adapter to cable connector to control unit.</p> <p>* Voltage signal Connect both cable connectors to adapter. Pull apart cable connection at needle-movement sensor. Make cable connection at needle-movement sensor.</p>	<p>1-grnd. 2-grnd. 3-grnd.</p> <p>2 - 7</p> <p>2 - 3</p> <p>1 - 3</p> <p>2 - 3 (+) (-)</p> <p>1 - 3</p>	<p>> 1 M Ω > 1 M Ω > 1 M Ω</p> <p>> 1 M Ω</p> <p>1.0...10.0 k Ω</p> <p>0.5...5.0 k Ω</p> <p>4.5...5.5 V</p> <p>0.79...0.97 V > 3.0 V</p>

* * = serious fault (occurrence results in steady light of indicator lamp during operation).

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/ function Test instructions/conditions	Termi- nals	Set values
14	Engine-speed sensor Conduct tests at multiple butt connector of component. * Short circuit to ground * Int. resistance at approx. 20° C * Engine-speed signal pattern - motortester, special input - run engine at idle speed Note: Positive signal peak must appear first.	 1 - 2 1 - 2 (+) (-)	 > 1 M Ω 900...1100 Ω see signal pattern

* * = serious fault (occurrence results in steady light of ind. lamp during op.)



SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
15	Solenoid-operated valve (start of injection)	<p>Conduct tests at multiple butt connector of component.</p> <ul style="list-style-type: none"> * Short circuit to ground * Internal resistance at approx. 60° C * Test measuring voltage (control unit) at disconnected multiple butt connector. * Actuation on/off ratio <ul style="list-style-type: none"> - coolant temperature approx. 80° C - connect pockettester to connected multiple butt connector - set dwell-angle range - run engine at idle speed - disconnect needle-movement sensor - connect needle-movement sensor <p>Test instruction: on/off ratio must change on disconnection of the needle-movement sensor or increase of the engine speed.</p>		<p>> 1 M Ω</p> <p>13.0...22.0 Ω</p> <p>approx. 12V</p>

TEST SPECIFICATIONS

Component/function

Set values

Idle speed (engine at norm. op. temp., approx. 80° C):

	Vehicle at stand-still	Road speed (>2 km/h)
Manual trans.	750 min -1	820 min -1
Automatic trans.	750 min -1	750 min -1
Air-cond. control switched on	865 min -1	865 min -1
Engine cold	750...1045 min -1	

Nozzle-opening pressure: 150 + 8 bar

Coordination, pump - engine (inj. timing):

Setting:

* Engine position: Cylinder 1 at TDC
* Pump position: 1.05 mm after BDC

Check value:

* Engine position: Cylinder 1 at TDC
* Pump position: 1.03 - 1.07 mm after BDC

Compression: 25...30 bar

Max. diff. between cylinders: 5 bar

Filter test, max. permissible differential pressure: 0.3 bar

Pressure drop: max. permissible 25 %

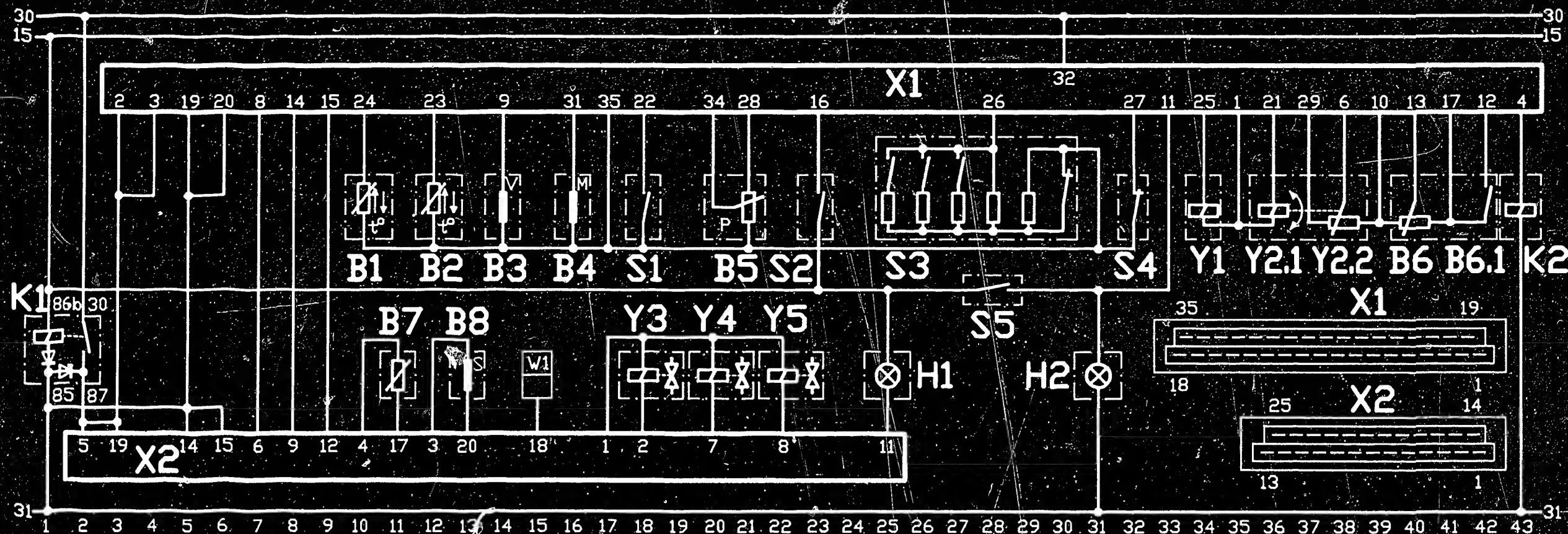
Vacuum, vacuum pump >500 mbar

Electropneum. switch-over valve 27...33 Ω

TEST SPECIFICATIONS (CONTINUED)

Tightening torques

Fuel lines	25 Nm
Fastening screws, injection pump	20 Nm
Fastening screws, nozzle-holder assembly	40...45 Nm
Sheathed-element glow plugs	25 Nm
Screw plug	15 Nm
Cylinder-head-cover screws	7.5 Nm
Nut, injection-pump drive gear	45...50 Nm
Nut, camshaft gear	65...70 Nm
Tensioning-wheel mounting on engine (nut and bolt)	20...24 Nm
Toothed-belt pulley of jack shaft	55...65 Nm
V-belt pulley/vibration damper	22...24 Nm
Tensioning torque for tensioning-roller mounting (new toothed belt)	45...50 Nm
Tightening torque for tensioning-roller mounting (toothed-belt already run > 16 000 km)	30...35 Nm
Bleeder screw/thermostat housing	6...10 Nm



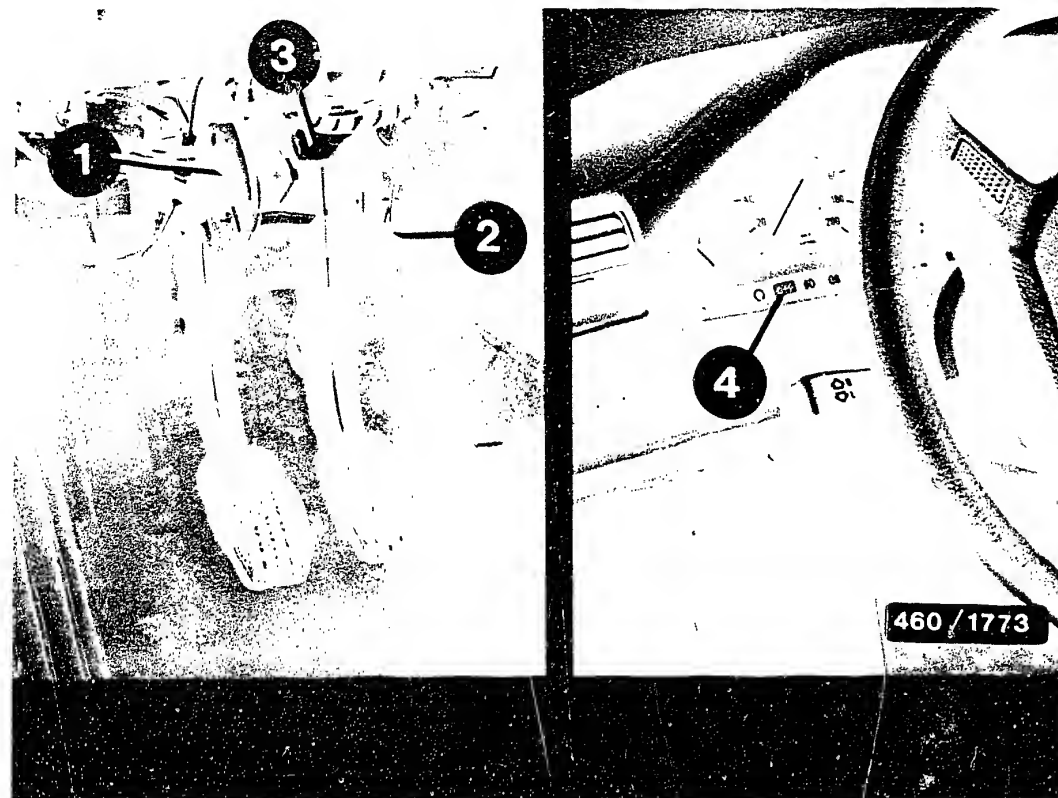
460/1716

B1 = Temperature sensor (fuel)
 B2 = Temperature sensor (coolant)
 B3 = Road-speed sensor
 (speedometer signal)
 B4 = Engine-speed sensor
 B5 = Charge-air pressure sensor
 B6 = Accelerator-pedal sensor
 B6.1 = Idle switch
 B7 = Temperature sensor (air)
 B8 = Needle-movement sensor
 H1 = Diagnosis indicator
 H2 = Stop lamps
 K1 = Reversed-polarity protection relay
 ELECTRICAL TERMINAL DIAGRAM

K2 = Electric shutoff device
 S1* = Switch (transmission indicator)
 S2 = Switch (air conditioner)
 S3 = Operating element, closed-loop
 road-speed control
 S4 = Switch (clutch)
 S5 = Switch (brake)
 W1 = Diagnosis stimulation
 X1 = Control-unit plug 1
 X2 = Control-unit plug 2
 Y1 = Electropneum. press. transducer
 (clsd-loop chg-air press. ctrl.)

Y2.1 = Delivery controller
 Y2.2 = Control-collar-travel sensor
 Y3 = Solenoid-operated valve
 (start of injection)
 Y4 = Electropneumatic switch-over
 valve (EGR)
 Y5* = Elektropneumatic switch-
 over valve

(* Vehicles with
 automatic transmission only)

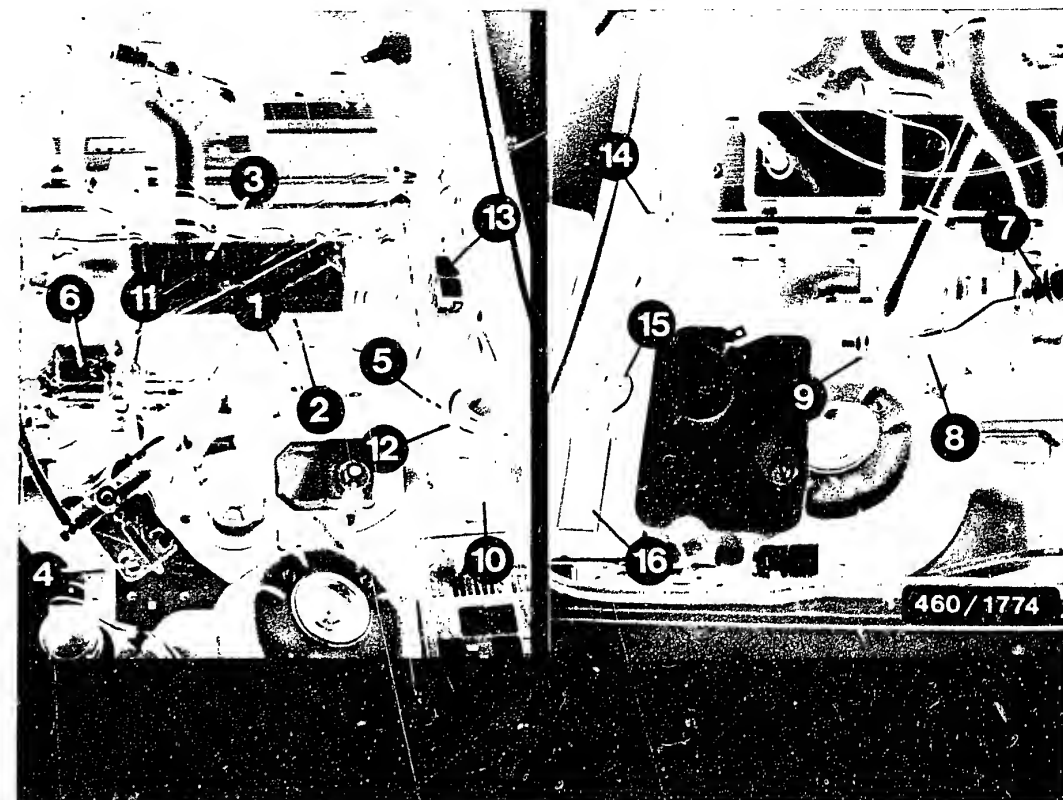


- 1 = Accelerator-pedal sensor
- 2 = Switch (brake)
- 3 = Switch (clutch)
- 4 = Diagnostic lamp (in connection with water-level sensor indicator)

INSTALLATION POSITION OF COMPONENTS

Road-speed sensor is built onto the differential housing.

Control units are installed in the glove compartment.



- 1 = Temperature sensor (air)
- 2 = Temperature sensor (coolant)
- 3 = Nozzle-holder assembly with NBF (cyl. 4)
- 4 = Charge-air pressure sensor
- 5 = Engine-speed sensor
- 6 = Injection pump
- 7 = Control box (LDR)
- 8 = Bypass valve actuator
- 9 = Exhaust-gas recirculation valve
- 10 = Diagnostic plug
- 11 = ELAB
- 12 = Engine plug
- 13 = Reversed-polarity protection relay
- 14 = Electropneumatic switch-over valve (EGR)
- 15 = Electropneumatic pressure transducer (LDR)
- 16 = Glow-duration control unit

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Solenoid-operated valve (start of injection) and fuel-temperature sensor are integral in the injection pump.

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diesel fuel injection
(EDC = Electronic Diesel
Control)

Make of vehicle : BMW

Basic microcard : PKW-083

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of publication, apply to the following
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with electronically controlled diesel fuel
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vehicle-specific special features and test
specifications (set values).

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the trouble-shooting chart leads to various
causes/component faults.
Detailed instructions for trouble-shooting
must be taken from the basic instructions
via the trouble-shooting chart.

ATTENTION:
Even if reference is made to basic instructions,
the set values, terminal assignments and special
features of t h e s e vehicle-related brief
instructions are a l w a y s binding.

SAFETY AND PRECAUTIONARY MEASURES

Always observe these measures in order to prevent damage to the engine, control units and peripheral components of the EDC.

1. For testing the compression, disconnect the lead from the ELAB (electric shutoff device).
2. In the case of nozzle-holder assemblies with inductive start-of-injection sensor, the after-sales service workshop is permitted to adjust only the nozzle-opening pressure.
3. Never start the engine when the battery terminals are not firmly connected.
4. Do not use a fast charger for starting the engine.
Starting aid may be provided using only a second 12 V battery and jump leads.
5. Disconnect the battery from the vehicle electrical system before boost charging.
6. Never disconnect the battery from the vehicle electrical system when the engine is running.
7. Never disconnect or connect control-unit plugs when the ignition is switched on.
8. Remove control units when the temperature exceeds + 80° C (paint-drying installation).
9. When welding on the vehicle (electric spot welding), remove control units.
10. The protective hose at the cable connection to the injection pump must be replaced after work on the plug-in connection.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Diagnostic lamp lights
2. Starting motor operates, but engine fails to start or starts only with difficulty (when warm or cold)
3. Engine hunts when idling
4. Rough idling when engine is warm
5. Fuel consumption high, maximum engine power not reached, and smoke formation
6. Unsatisfactory performance
7. Black smoke in full-load range, engine running rough; possibly lack of power
8. Engine running rough

							Cause (component fault)
*							Self-diagnosis
*							Voltage supply, control units
	*						Delivery controller
	*						Spool-travel sensor
	*						ELAB
	*			*	*		Computer monitoring
				*	*		Solenoid op. valve (start of injection)
					*		Electropneumatic switch-over valve (EGR)
				*			Nozzle-holder assembly with needle-movement sensor (NBF)
				*			Computer interface
	*				*		Engine-speed sensor
*							Engine-speed sensor and NBF
*							Tank empty, tank vent
*	*			*			Injection sequence, not firing sequence
	*						Inlet-union screw, fuel return
*	*						Air in fuel system
*							Paraffin separation
*		*					Fuel lines leaking
*							Supply lines clogged
*		*		*	*		Injection nozzle
*	*	*		*			Coordination, pump - engine (inj. timing)
*							Fuel filter
*							Pre-heating system
*	*	*					Engine compression
		*					Engine air filter
		*					Engine timing

TROUBLE-SHOOTING CHART (Continued)

Customer complaint (symptoms of trouble)

9. Engine misfiring during vehicle operation
10. Engine cuts out of its own accord
11. Engine running at constant engine speed
12. Engine will not rev up when cold
13. High idle and engine running rough at high engine speed
14. Black smoke in full-load range
15. Fog-like smoke in full-load range (white)

Cause (component fault)

*	*				Accelerator-pedal sensor
*					Delivery controller
*		*			Spool-travel sensor
*					Computer monitoring
*					Engine-speed sensor and NBF
*	*	*		*	Tank empty, tank ventilation
*	*	*		*	Injection sequence not firing sequence
*		*		*	Inlet-union screw, fuel return
*		*		*	Air in fuel system
		*			Paraffin separation
*					Fuel lines leaking
*		*		*	Supply lines clogged
		*		*	Coordination, pump - eng. (injec. timing)
		*		*	Fuel filter
		*			Engine compression
	*				Safety switch, accelerator-pedal sensor
*					Fuel heater

TROUBLE-SHOOTING CHART (Continued)

Customer complaint (symptoms of trouble)

16. Severe bucking, no idle increase during vehicle operation (manually shifted transmission)
17. Faults are not stored by self-diagnosis
18. Exhaust-gas recirculation not functioning
19. No low-idle-speed increase
20. Unsatisfactory performance
21. Black smoke in full-load range, engine running rough; possibly lack of power

Cause (component fault)

*	*				Computer monitoring
*	*				Solenoid-op. valve (start of injection)
*	*				Electropneumatic switch-over valve (EGR)
*	*				Nozzle-holder assembly with NBF
*	*				Engine-speed sensor
*	*				Road-speed sensor
*	*				Switch, clutch or brake
*	*				Temperature sensor (air)
*	*				Temperature sensor (coolant)
	*				Switch, air conditioner
		*			Turbo-supercharger
			*		EGR valve
			*		Timing device

TROUBLE-SHOOTING

How to use the self-diagnosis

Trouble-shooting (testing) must always begin with self-diagnosis.

In position 2 of the key-operated switch, the diagnostic lamp lights up for approx. 5 seconds (lamp test).

If the diagnostic lamp does not light up after actuation of the key-operated switch, test the self-diagnosis.

Always note down the flashing-code output.

If the voltage supply for the control units is interrupted, the faults stored are cleared.

If a faulty operational path is indicated, pay particular attention to the following:

- * loose contacts at multiple cable connections
- * dirty, pushed-back or corroded plug contacts
- * breaks in lines at kinked or pinched locations.

Test instruction:

before disconnecting or connecting the control-unit plug, switch off the ignition.

SELF-DIAGNOSIS VIA EVALUATION OF FLASHING CODE

An integrated self-diagnosis system makes it possible to locate a faulty component or line path by means of a flashing code. The indicator lamp is located in the instrument panel.

Using the flashing-code evaluation unit KDAW 9980, the diagnostic program is activated by briefly connecting socket 15 (20-pin diagnostic plug) to ground.

The flashing-code output begins with the fault which was stored first of all. The faults are output one after the other. The program returns to the beginning once the last fault has been output (annular slide valve).

Evaluating the flashing code

1. Switch on ignition.
2. The self-diagnosis must be stimulated for at least 4 seconds.
3. Flashing code is indicated.
4. Repeat stimulation:
 - a. if there is no further fault, the same fault is indicated again
 - b. if there are further faults, these are indicated after each renewed stimulation. Once all the stored faults have been output, the first fault code stored is indicated (annular slide valve).

Clearing the flashing code

1. Position key-operated switch to position 2.
2. Actuate brake pedal and simultaneously stimulate the self-diagnosis.
3. Call up the self-diagnosis through renewed stimulation.
4. If the indicator lamp does not light, the fault memory has been cleared.

SELF-DIAGNOSIS TEST TABLE

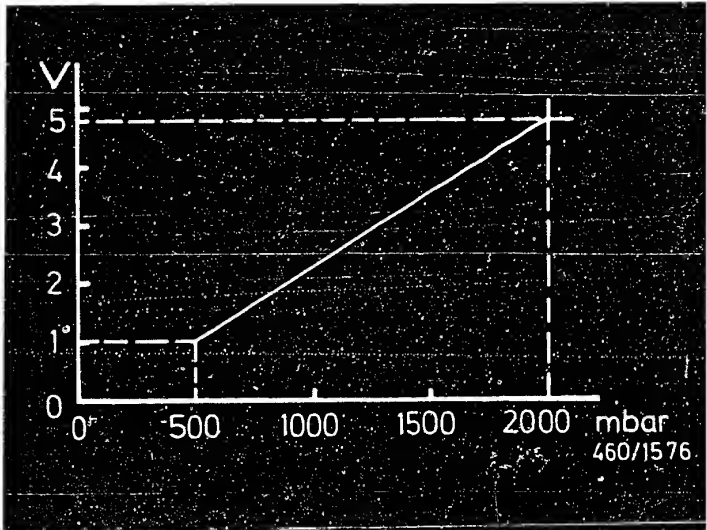
Fault indication Flashing code	Testing of component/function	Test instructions /Test conditions	Terminals	Set values
1	Temperature sensor (coolant)	Test resistance at component. +15...+30°C: Approx. 80°C: Test measuring voltage (control unit) at disconnected cable connector.		1300...3600 Ω 250...390 Ω approx. 5 V
2	Accelerator-pedal sensor	Conduct tests at component. * Internal resistance * Supply voltage * Voltage signal: -idle position -full-load position * Safety switch: -idle position -full-load position	2 - 4 2 - 4 (+) (-) 1 - 4 1 - 4 2 - 5 2 - 5	800...1400 Ω 4.5...5.5 V 0.23...0.50 V 2.79...5.0 V > 1 M Ω 600...1400 Ω
4	Temperature sensor (fuel)	Conduct tests at 7-pin cable connector of EDC distributor-type fuel-injection pump with aid of test adapter KDEP 1165 and adapter leads KDEP 1165/100 and -/101. * Short circuit to ground Connect adapter to cable connector to injection pump * Short circuit Connect adapter to cable connector to injection pump * Internal resistance at 15...30°C: (Connect adapter to cable connector to injection pump) * Measuring voltage (control unit): (Connect adapter to cable connector to control unit)	5-grnd. 6-grnd. 4 - 6 5 - 6 5 - 6	> 1 M Ω > 1 M Ω > 1 M Ω 1200...4000 Ω 4.5...5.5 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
5	Control unit, computer interface (stored)	No fault is present at the time of testing. Disconnect cable connector from control units 1 and 2. Check leads listed below for open circuit and contact resistance: Control unit 1 — Control unit 2 Term. 14 to term. 9 Term. 15 to term. 12		Approx. 0 Ω
5	Control unit 1 Computer monitoring	Fault in the computer monitoring is present only if the engine cannot be started after the flashing code has been indicated.		
(5)	Control unit 2 Computer monitoring	No indication by the indicator lamp after stimulation of the self-diagnosis. Exhaust-gas recirculation switched off. Disconnect multiple butt connector from solenoid-operated valve (start of injection). Test measuring voltage (control unit) at multiple butt connector.		Approx. 12 V
6	Temperature sensor (air)	Test resistance at component. 15...30° C: Approx. 80° C: Test measuring voltage (control unit) at disconnected cable connector.		1300...3600 Ω 250...390 Ω Approx. 5 V
7	Road-speed sensor	Test requirement: correct speed indication Measuring voltage (instrument cluster) at disconnected cable connection of pedal-position sensor (installed behind control units) <hr/> Test requirement: no speed indication Test component for proper functioning.	10(+) — (-)	>4.5 V 9 pointer deflections/ wheel rotation

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/function Test instructions/conditions	Termi- nals	Set values
8	Charge-air pressure sensor. Test component. * Supply voltage * Voltage signal (determine barometric pressure)	1 - 3 1 - 2	4.5...5.5 V see character- istic curve
10	Delivery controller. Conduct test at 7-pin cable connector of EDC distributor-type fuel-injection pump with the aid of the test adapter KDEP 1165 and the adapter leads KDEP 1165/100 and /-101. * Short circuit to ground Connect adapter to cable connector to injection pump * Internal resistance Connect adapter to cable connector to injection pump * Supply voltage Connect adapter to cable connector to control unit	4-grnd. 7-grnd. 4 -7 7-grnd.	> 1M Ω > 1M Ω 0.3...1.2 Ω 8.5...14.5 V

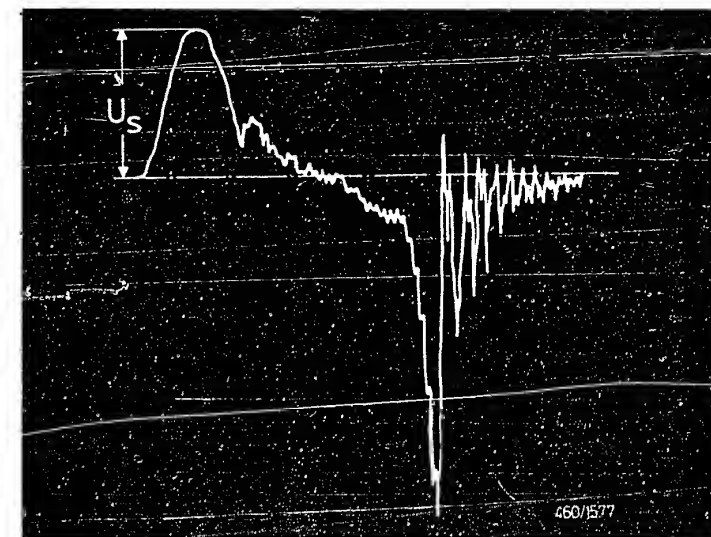


* * = Serious fault (occurrence results in steady light of indicator lamp during op.)

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/ function Test instructions/conditions	Termi- nals	Set values
11	<p>Needle-movement sensor. Conduct test at cable connector of component.</p> <p>* Short circuit to ground</p> <p>* Internal resistance approx. 20°C approx. 80°C</p> <p>* Supply voltage - cable connector disconnected - cable connector connected at approx. 80° C</p> <p>* Needle-stroke signal/signal voltage (U_s) - cable connector connected - run engine at idle speed - motortester, special input</p>		<p>> 1 M Ω</p> <p>90...110 Ω 111...135 Ω</p> <p>10.0...12.0 V 1.8... 8.8 V</p> <p>see signal pattern</p> <p>$U_s = > 150$ mV.</p>

* * = serious fault (occurrence results in steady light of indicator lamp during op.)



SELF-DIAGNOSIS TEST TABLE (CONTINUED)

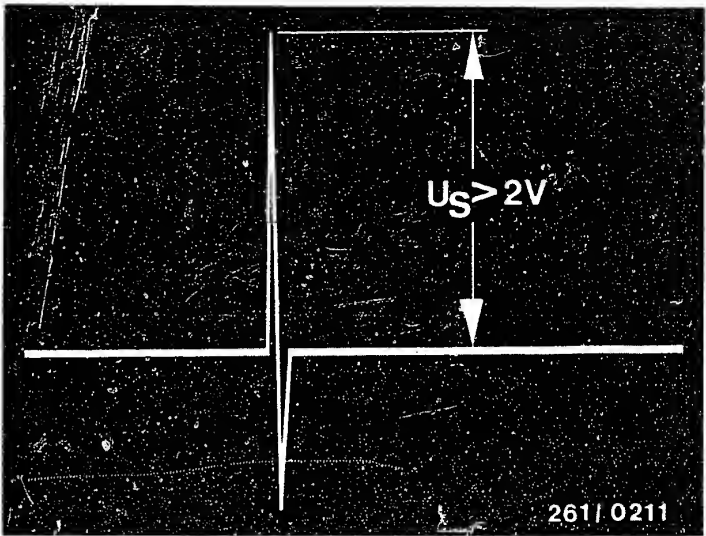
Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
12	Spool-travel sensor	<p>Conduct tests at 7-pin cable connector of EDC distributor-type fuel-injection pump with aid of test adapter KDEP 1165 and adapter leads KDEP 1165/100 and -/101</p> <p>* Short circuit to ground Connect adapter to cable connector to injec. pump</p> <p>* Short circuit Connect adapter to cable connector to injec. pump</p> <p>* Resistance, potentiometer path Connect adapter to cable connector to injec. pump.</p> <p>* Resistance, wiper path Connect adapter to cable connector to injec. pump.</p> <p>* Supply voltage Connect adapter to cable connector to control unit.</p> <p>* Voltage signal Connect both cable connectors to adapter. Pull apart cable connection at needle-movement sensor. Make cable connection at needle-movement sensor.</p>	<p>1-grnd. 2-grnd. 3-grnd.</p> <p>2 - 7</p> <p>2 - 3</p> <p>1 - 3</p> <p>2 - 3 (+) (-)</p> <p>1 - 3</p>	<p>> 1 M Ω > 1 M Ω > 1 M Ω</p> <p>> 1 M Ω</p> <p>1.0...10.0 k Ω</p> <p>0.5...5.0 k Ω</p> <p>4.5...5.5 V</p> <p>0.79...0.97 V > 3.0 V</p>

* * = serious fault (occurrence results in steady light of indicator lamp during operation).

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/ function Test instructions/conditions	Termi- nals	Set values
14	Engine-speed sensor Conduct tests at multiple butt connector of component. * Short circuit to ground * Int. resistance at approx. 20° C * Engine-speed signal pattern - motortester, special input - run engine at idle speed Note: Positive signal peak must appear first.	 1 - 2 1 - 2 (+) (-)	 > 1 M Ω 900...1100 Ω see signal pattern

* * = serious fault (occurrence results in steady light of ind. lamp during op.)



SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
15	Solenoid-operated valve (start of injection)	<p>Conduct tests at multiple butt connector of component.</p> <ul style="list-style-type: none"> * Short circuit to ground * Internal resistance at approx. 60° C * Test measuring voltage (control unit) at disconnected multiple butt connector. * Actuation on/off ratio <ul style="list-style-type: none"> - coolant temperature approx. 80° C - connect pockettester to connected multiple butt connector - set dwell-angle range - run engine at idle speed - disconnect needle-movement sensor <hr/> <ul style="list-style-type: none"> - connect needle-movement sensor <p>Test instruction: on/off ratio must change on disconnection of the needle-movement sensor or increase of the engine speed.</p>		<p>> 1 M Ω</p> <p>13.0...22.0 Ω</p> <p>approx. 12V</p>

TEST SPECIFICATIONS

Component/Function

Set values

Idle speed (engine at norm. op. temp., approx. 80° C):

	Vehicle at standstill	Road speed (>2 km/h)
Manual trans.	705 min ⁻¹	865 min ⁻¹
Automatic trans.	705 min ⁻¹	705 min ⁻¹
Air-cond. control switched on	865 min ⁻¹	865 min ⁻¹
Engine cold	705...1090 min ⁻¹	

Nozzle-opening pressure 150 + 8 bar

Coordination, pump - engine (inj. timing):

Setting:

- * Engine position: Cylinder 1 at TDC
- * Pump position: 1.05 mm after BDC

Check value:

- * Engine position: Cylinder 1 at TDC
- * Pump position: 1.03 - 1.07 mm after BDC

Charge-air pressure: max. 1850 + 50 mbar at
(charge-air pressure + atmospheric pressure) full load as of 2250 min ⁻¹

Compression: 25...30 bar

Max. diff. between cylinders: 5 bar

Filter test, max. permissible differential pressure: 0.3 bar

Pressure drop: max. perm. 25 %

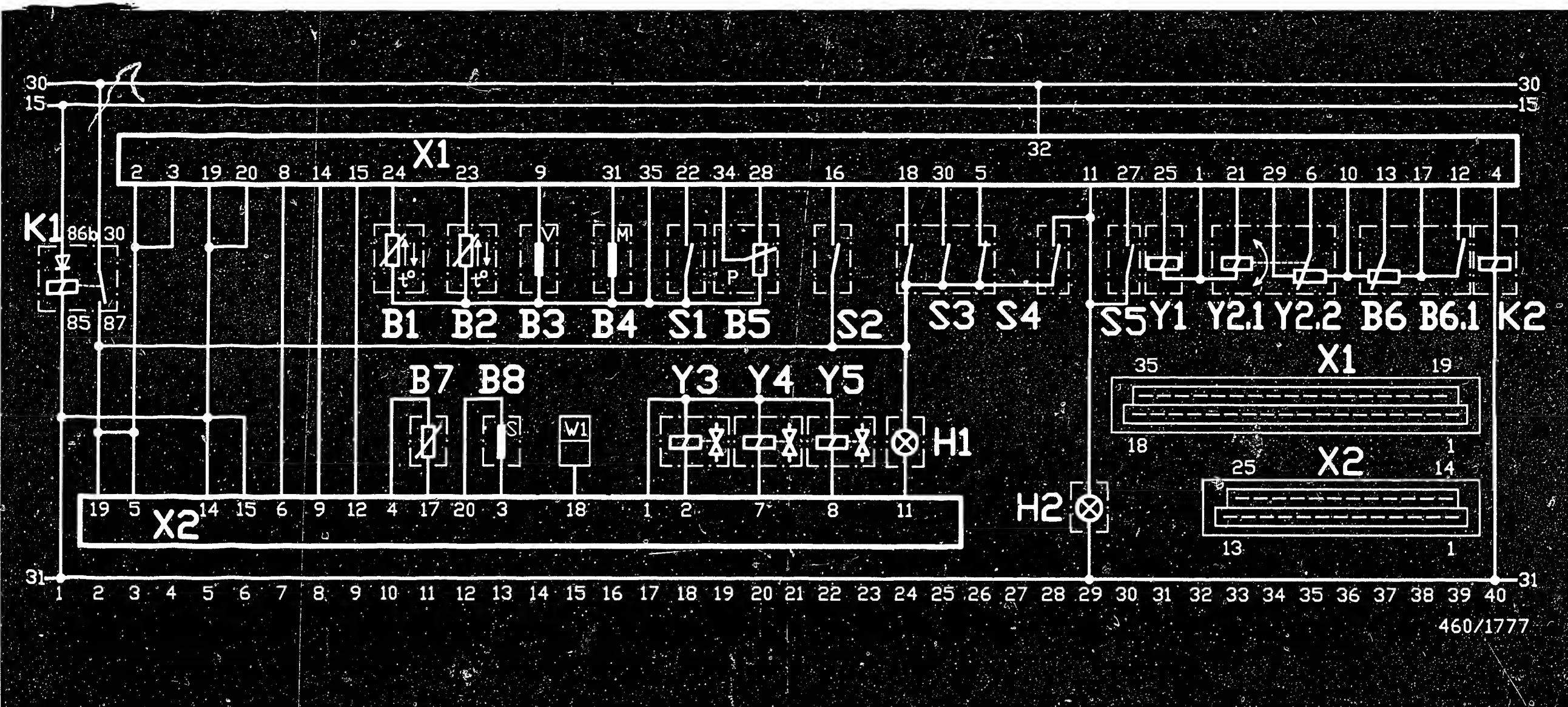
Vacuum, vacuum pump >500 mbar

Electropneum. switch-over valve 27...33 Ω

TEST SPECIFICATIONS (CONTINUED)

Tightening torques

Fuel lines	25 Nm
Fastening screws, injection pump	20 Nm
Fastening screws, nozzle-holder assembly	40...45 Nm
Sheathed-element glow plugs	25 Nm
Screw plug	15 Nm
Cylinder-head-cover screws	7.5 Nm
Nut, injection-pump drive gear	45...50 Nm
Nut, camshaft gear	65...70 Nm
Tensioning-wheel mounting on engine (nut and bolt)	20...24 Nm
Toothed-belt pulley of jack shaft	55...65 Nm
V-belt pulley/vibration damper	22...24 Nm
Tensioning torque for tensioning-roller mounting (new toothed belt)	45...50 Nm
Tightening torque for tensioning-roller mounting (toothed-belt already run > 16 000 km)	30...35 Nm
Bleeder screw/thermostat housing	6...10 Nm

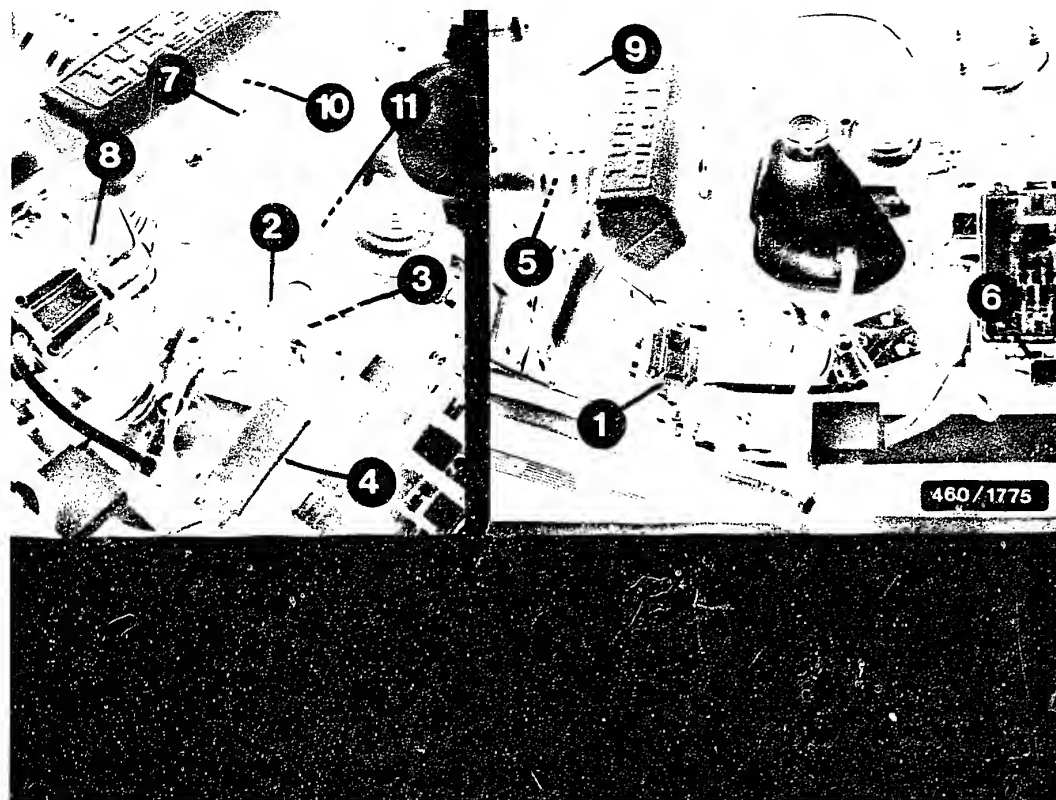


460/1777

B1 = Temperature sensor (fuel)
 B2 = Temperature sensor (coolant)
 B3 = Road-speed sensor
 (speedometer signal)
 B4 = Engine-speed sensor
 B5 = Charge-air pressure sensor
 B6 = Accelerator-pedal sensor
 B6.1 = Idle switch
 B7 = Temperature sensor (air)
 B8 = Needle-movement sensor
 H1 = Diagnosis indicator
 H2 = Stop lamps
 K1 = Reversed-polarity protection relay

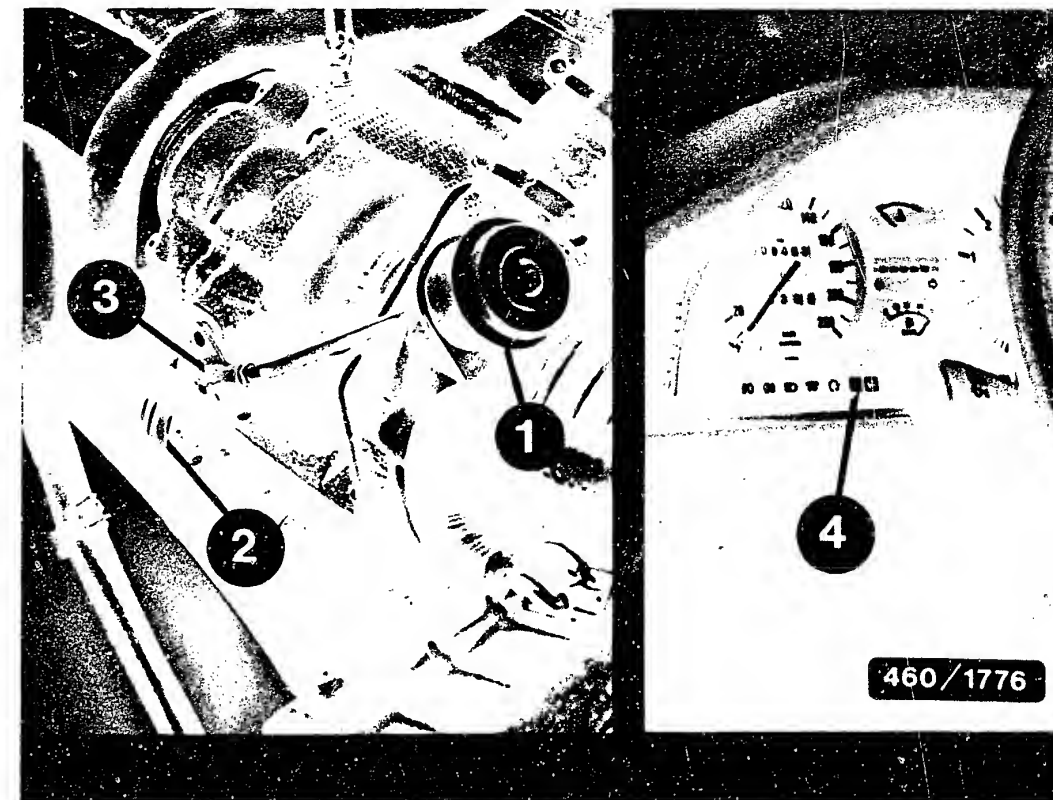
K2 = Electric shutoff device
 S1* = Switch (transmission indicator)
 S2 = Switch (air conditioner)
 S3 = Operating element, closed-loop
 road-speed control
 S4 = Switch (clutch)
 S5 = Switch (brake)
 W1 = Diagnosis stimulation
 X1 = Control-unit plug 1
 X2 = Control-unit plug 2
 Y1 = Electropneumatic pressure
 transducer
 Y2 = Injection pump

Y2.1 = Delivery controller
 Y2.2 = Control-collar-travel sensor
 Y3 = Solenoid-operated valve
 (start of injection)
 Y4 = Electropneumatic switch-over
 valve (EGR)
 Y5* = Elektropneumatic switch-
 over valve
 (* Vehicles with
 automatic transmission only)



- 1 = Fuel-injection pump
- 2 = Charge-air pressure sensor
- 3 = Electropneumatic switch-over valve (EGR)
- 4 = Glow-duration control unit
- 5 = Injection nozzle with NBF (cylinder 4)
- 6 = Reversed-polarity protection relay
- 7 = Temperature sensor (air)
- 8 = ELAB
- 9 = Diagnostic plug
- 10 = Temperature sensor (coolant)
- 11 = Engine-speed sensor

INSTALLATION POSITION OF COMPONENTS



- 1 = Control box
- 2 = Exhaust-gas recirculation valve
- 3 = Bypass-flap actuator
- 4 = Diagnostic lamp

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Solenoid-operated valve (start of injection) and temperature sensor (fuel) are installed in the fuel-injection pump.

Switches (clutch/brake) are mounted above the pedals.

Accelerator-pedal sensor is located to the left of the clutch pedal, above the pedal.

Road-speed sensor is mounted on the differential housing.

Control units are installed in the glove compartment.

TABLE OF CONTENTS

Trouble-shooting instructions	: POR-5004
BOSCH system	: Headlight vertical aim control
Make of vehicle	: PORSCHE
Basic microcard	: MB-524

Section	Coordinate
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Special features, safety, usage.....	02
Trouble-shooting chart.....	03
Rapid diagnosis chart for the head- light aiming device.....	04
Test specifications.....	06
Diagram of air lines.....	07
Installation position of components.....	08

SPECIAL FEATURES

- * This microcard contains the trouble-shooting instructions for headlight vertical aim control for the following models, valid at the time of publishing:

Type 911 Carrera (01.87 ->)
Type 911 Turbo 3.3 (01.87 ->)
- * The LWR system installed in these vehicles essentially corresponds to the LWR system with vacuum reservoir used in Mercedes-Benz vehicles with level control.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to various causes/component faults. Detailed instructions for trouble-shooting must be taken from the basic instructions via the trouble-shooting chart.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

Finding individual test steps in the brief and basic instructions is made easier through the use of identical test-step numbers.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to prevent damage to the engine, control unit or ignition system, be sure to observe the safety and precautionary measures in the basic instructions.

* C A U T I O N !
High-performance ignition system.
Dangerous primary and secondary voltages.

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

For further precautionary measures, see basic instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Headlight setting too high or too low.
2. Headlight cannot be adjusted by LWR system.
3. Light/dark boundary flickers during driving.

Cause (component fault)	
*	Check basic headlight setting
* *	Headlight mechanically defective
*	Vacuum system leaking
*	Actuator defective
*	Rheostat-type switch defective
*	Non-return valve defective
*	Mounting of actuator defective

RAPID DIAGNOSIS CHART FOR TESTING WITH HEADLIGHT AIMING DEVICE 0 681 130 .. OR 0 684 100 ..
 Perform tests on both headlights in each case!

Test step	Function	Remarks	Set headlight aiming device to:	Set headlights to:	Reading on headlight aiming device
1	Basic headlight setting	Set rheostat-type switch to: "0" Position (basic setting). Engine running.	- 10 cm inclination	Light/dark boundary	—
2	Maximum low adjustment	Set rheostat-type switch to: "2" position. Engine running.	Light/dark boundary	—	Between - 17 cm and - 29 cm
3	Maximum upper adjustment	Set rheostat-type switch to: "0" position (basic setting). Engine running.	- 20 cm inclination	Light/dark boundary	—
		Set rheostat-type switch to: "1" position (adjustment upwards). Engine running.	Light/dark boundary	—	Between - 9 cm and - 18 cm
4	Basic setting	Set rheostat-type switch to: "0" position (basic setting). Engine running.	- 10 cm inclination	Light/dark boundary	—
5	Leakage in vacuum system	Set rheostat-type switch to: "0" position (basic setting). Switch off engine.	- 10 cm inclination	—	Light/dark boundary may move by max. \pm 4 cm.

TEST SPECIFICATIONS

Adjustment travel of the actuators:

Upper adjustment min. + 0.8 mm
Lower adjustment min. - 1.3 mm
from "0" position of the rheostat-type switch in each case.

Basic headlight setting: H - 10 cm

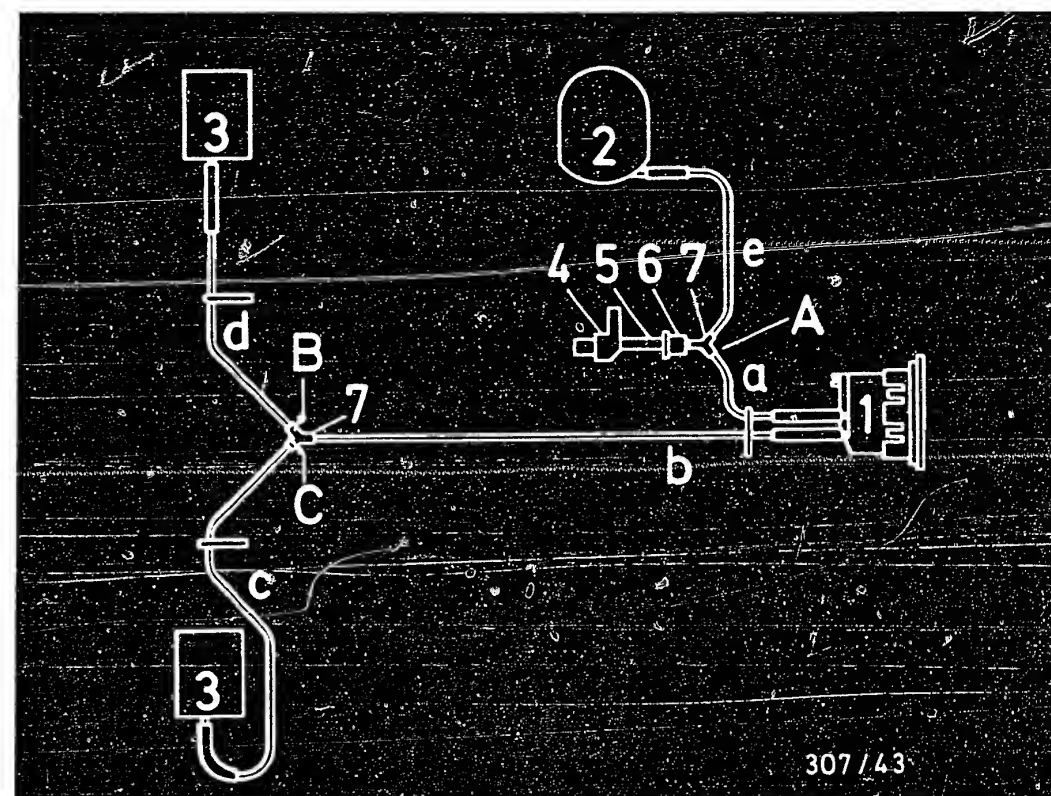
Vacuum values at the actuators with the engine running and with a vacuum of approx. 550 mbar at the rheostat-type-switch input:

Rheostat-type-switch position | Vacuum set values

"1" (upward adjustment)	370 (330) \pm 30 mbar
"0" (basic setting)	250 \pm 30 mbar
"1" (downward adjustment)	160 (170) \pm 30 mbar
"2" (downward adjustment)	80 (11) \pm 30 mbar

Note:

The values given in brackets apply to the rheostat-type switches used at the start of production in a number of vehicles.



DIAG. OF AIR LINES OF THE HEADLIGHT VERT. AIM CONTROL SYS.

A,B,C = Test connections

a = Line to input of rheostat-type switch
b = Line to output of rheostat-type switch
c = Line to actuator, left
d = Line to actuator, right
e = Line to vacuum reservoir

1 = Rheostat-type switch
2 = Vacuum reservoir
3 = Actuators, left and right
4 = Non-return valve on brake power-assist unit
5 = Connecting hose
6 = Non-return valve for LFR
7 = Branch piece

INSTALLATION POSITION OF COMPONENTS

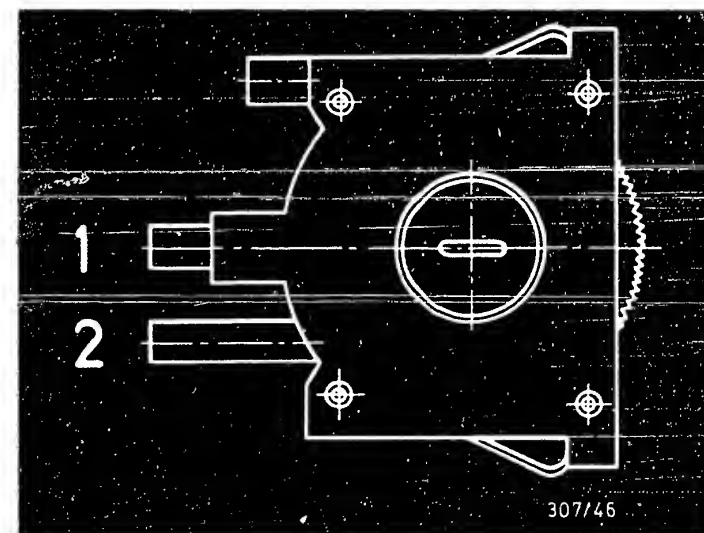
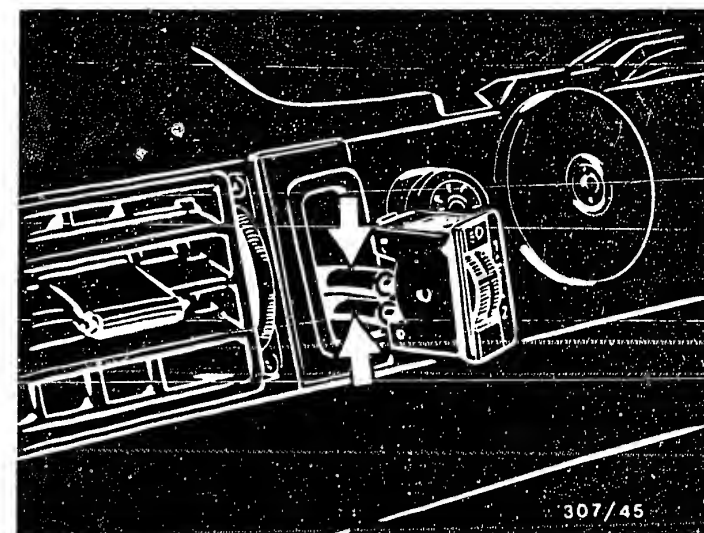
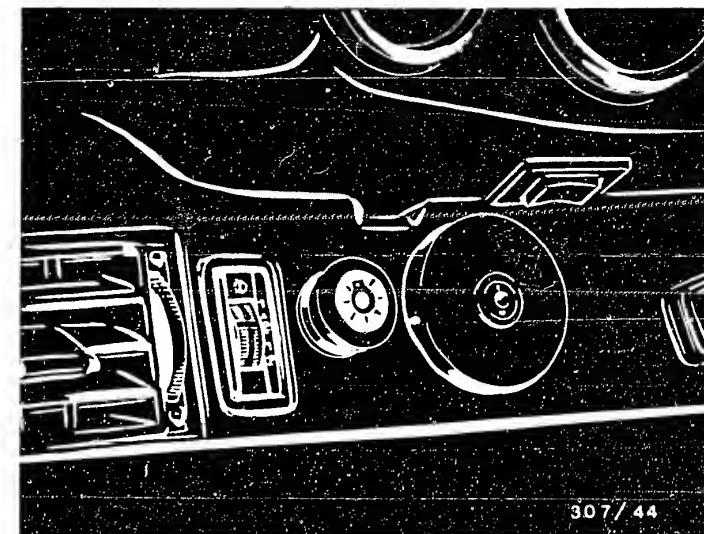
The rheostat-type switch of the headlight vertical aim control system is located in the instrument panel next to the light switch, see upper illustration.

Note on removal:

Push the rheostat-type switch out from below by hand, center illustration. Disconnect fibre-optic cable and vacuum hoses. The connection 2 and the respective vacuum hose are marked with a yellow spot, lower illustration.

The rheostat-type switch of the headlight vertical aim control system has 4 knotted positions:

- Position"1" : Luggage compartment loaded (upward adjustment) + 1 or 2 passengers
- Position"0" : Basic setting, 1-2 passengers
- Position"1" : 3 passengers (downward adjustment)
- Position"2" : 4 passengers (upward adjustment)



INSTALLATION POSITION OF COMPONENTS (Continued)

The vacuum reservoir is located beneath the right-hand fender. Access may be gained to the vacuum connection via the luggage compartment.

Note on removal:

Fold back matting, disconnect vacuum hose, loosen fastening nuts.

The vacuum siphoner for the headlight vertical aim control system is located at the non-return valve of the brake power-assist unit.

The actuators are secured to the headlights by means of a bayonet fitting.

Note on removal:

Unscrew the fastening screw from the headlight covering and prise off the covering at its lower section using a wooden spatula or similar tool.

Unscrew the screws of the headlight mounting and remove the headlight unit.

Unlatch the retainer from the actuator and unhook the operating rod.

Turn the actuator counterclockwise and remove.

Note:

When installing the actuator, insert in such a way that the vacuum connection points inward.

Trouble-shooting instructions : VOL-5001
BOSCH system : LU-Jetronic
Make of vehicle : VOLVO
Basic microcard : OPE-512

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Structure, usage.....	03
Safety and precautionary measures.....	03
Trouble-shooting chart.....	04
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Installation position of components.....	15

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models with 1.986 l/4-cyl. engine:

Volvo 360 2.0 Injection
CH/D/J version 01.86->

- * LU1-Jetronic with 25-pin control unit:
0 280 000 346.
- * Engine-speed triggering by term. 1 of the ignition coil.
- * 5-pin air-flow sensor and 7-pin control relay.
- * Solenoid-operated injection valves with brass-wire coil.
- * Starting enrichment by means of cold-start valve and thermo-time switch.
- * Lambda closed-loop control with heated sensor.
- * No test lead from term. 22 to engine compartment for integrator-voltage measurement.
- * Testing of lambda closed-loop control by CO measurement upstream of the catalytic converter.
- * 3-way exhaust-gas catalytic converter
- * For testing the fuel pressure, connect pressure tester with connecting piece KDJE-P 100/13 to the fuel-distribution pipe.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.

For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Prevent fuel from being injected during the compression test.
For this reason, disconnect control relay.

For further precautionary measures, see basic instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, fuel injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)											
*	*	*	*	*	*	*	*	*	*	*	Universal test adapter
*											Electric fuel pump
*	*	*	*								Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*	*			Air-flow sensor/air-mass sensor
*	*	*	*		*						Intake system
		*	*	*		*	*				Solenoid-operated injection valves
*	*	*			*	*					Fuel pressure
				*	*						Fuel quantity
		*	*	*	*	*					Throttle valve
				*							Overrun cut-off
*		*									Start control
				*							Ground
*	*	*	*	*	*						Alternator, interference suppress.
		*	*	*		*					CO exhaust-gas adjustment
				*							Control unit
						*					Catalytic converter
	*	*	*	*							Lambda closed-loop control

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
 Adapter lead: 1 684 463 123

Test step	Switch V	Ω	Termi- nals	Testing of component/function	Test instructions/ Test conditions	Set values
1	5	-	1 - 5	Voltage pulses from ignition coil term. 1	Shift into neutral, start engine	Ignition pulses on oscilloscope
2	6	-	9 - 5 (+) (-)	Voltage from control relay term. 87	Shift into neutral, start engine	8...15 V
3	7	-	4 - 5 (+) (-)	Voltage from ignition and starting switch term. 50	Shift into neutral, start engine	8...15 V
4	 V	11	8 - 5	Resistor set in air-flow sensor	—	100...200 Ω
5	 V	12	7 - 5	Resistance of potentio- meter in air-flow sensor	Deflect air-flow sensor flap as far as it will go.	60...1000 Ω
6	 V	13	10 - 5	Resistance, temperature sensor (engine)	+15...+30°C: Approx. +80°C:	1,45...3,3 k Ω 280...360 Ω
7	 V	14	13 - 5	Frame connection of output stage		0...10 Ω

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 123

Test step	Switch	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
8	V	16	2 - 9	Resistance of idle contact	Accelerator pedal in rest position : Slightly depress accelerator pedal : 0...10 Ω infinity Ω
9	V	17	3 - 9	Resistance of full-load contact	Accelerator pedal in rest position : Fully depress accelerator pedal : infinity Ω 0...10 Ω
10	V	18	12 - 9	Resistance of shunt-connected solenoid-operated injection valves	+15...+30°C : Approx. +80°C : 7,0...9,5 Ω 7,2...10,0 Ω

REMARK: The following components and their respective connecting leads are not covered in the test by the universal test adapter:

1. Auxiliary-air device: positive lead from term. 87 of control relay, negative lead to engine ground.
2. Electric fuel pump: positive lead from term. 87b of control relay (over pump fuse), negative lead to vehicle ground.
3. Sensor heater: positive lead from term. 87b of control relay (over sensor fuse), negative lead to engine ground.
4. Lambda sensor: sensor lead to control unit term. 20 (shielding at term. 5), sensor housing to vehicle ground.
5. Cold-start valve: positive lead from term. 50 of ignition and starting switch, negative lead to thermo-time switch term.W.
6. Thermo-time switch: at term.G, positive from term. 50 of ign.and starting switch, thermo-time-switch housing to eng. ground.

TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Fuel delivery and return:	at least 700 cm ³ /30 s
* Supply voltage under load:	at least 12 V
Pressure regulator	
* Fuel pressure with engine at standstill:	2,3...2,7 bar
at idle:	approx. 0.5 bar lower
Fuel system, leakages	
* Fuel pressure after 20 mins. with engine at standstill:	at least 1.0 bar
Auxiliary-air device	
* Resistance value	35...70 Ω
Air-flow sensor	
* Resistance value between	
term. 8 and term. 5:	340 ... 450 Ω
term. 7 and term. 5:	60 ...1000 Ω 1)
term. 9 and term. 5:	500 ... 760 Ω
term. 8 and term. 9:	160 ... 300 Ω
1) (Fully deflect air-flow sensor flap)	
Temperature sensor (engine)	
* Internal electrical resistance at ambient temperature	
+15...+30°C:	1,45...3,3 k Ω
With engine at warm. op. temp. approx. +80°C :	280...360 Ω
Lambda-sensor heater	
* Internal electrical resistance (PTC) with engine at standstill:	1...15 Ω

TEST SPECIFICATIONS (Continued)

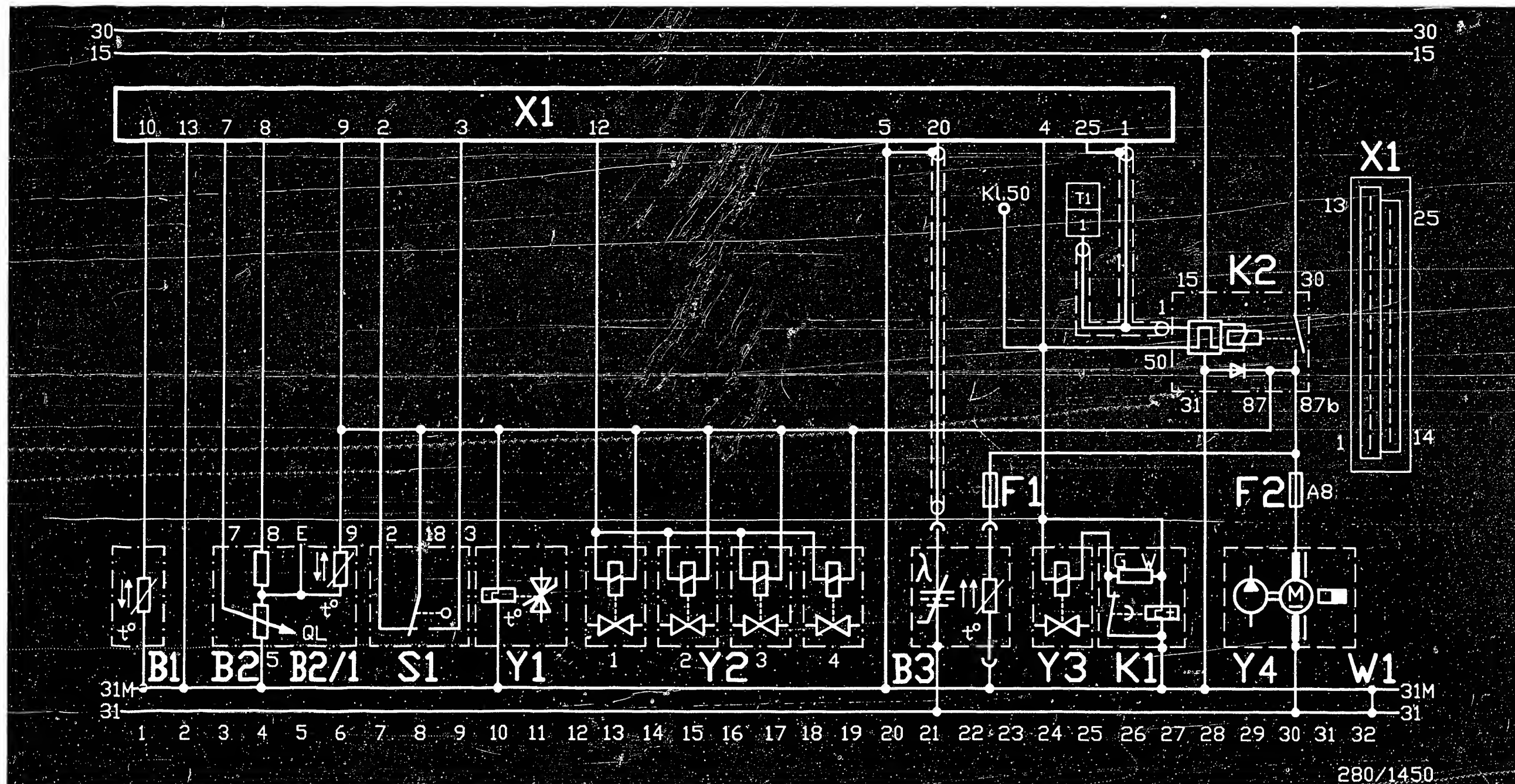
Component/Function	Set values
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature +15...+30°C:	14.5...17.0 Ω
* Leakage after 60 s:	no drop may fall
Thermo-time switch 35°C / 7,5 s	
* Internal electrical resistance between:	Below +30°C Above +40°C
Terminal G and ground:	25...40 Ω 50...80 Ω
Terminal W and ground:	0 Ω 100...160 Ω
Terminal G and terminal W:	25...40 Ω 50...80 Ω
Cold-start valve	
* Internal electrical resistance:	3,5...4,5 Ω
* Leakage, maximum permissible:	1 drop/min.
Idle adjustment	
Engine at normal operating temperature, approx.+80°C	
* Idle speed:	850...950 min ⁻¹
* CO content	
Measuring point upstream of the catalytic converter, pull apart lambda-sensor plug.	
Test specification:	0,4...0,8 % by vol.
Setting:	0,6 % by vol.
Connect sensor plug:	Engine speed and CO must remain unchanged.

TEST SPECIFICATIONS (CONTINUED)

Component/function	Set values
<hr/>	
Lambda closed-loop control Allow engine at operating tempera- ture to idle. Detach tank- ventilation hose. Measure CO- content ahead of catalytic converter.	
* Rich value Disconnect Lambda sensor plug and connect control- unit end to ground:	CO-content increases to above 0,7 vol. %
Only perform measurement briefly.	
* Lean value Apply 2 V to control-unit end of sensor lead:	drops below 0,5 vol % Engine does not run smoothly
* Closed-loop control value Connect sensor plug. Attach tank-ventilation hose:	0,4...0,8 vol %
Detach intake-manifold pressure actuator (air hose) at pressure regulator:	briefly increases and drops back to closed- loop control value above
Switch off suction plant during exhaust-emission measurement and adjustment.	

See equipment and Autodata microcards for settings as
regards ignition, valve clearance and other engine-
related data.

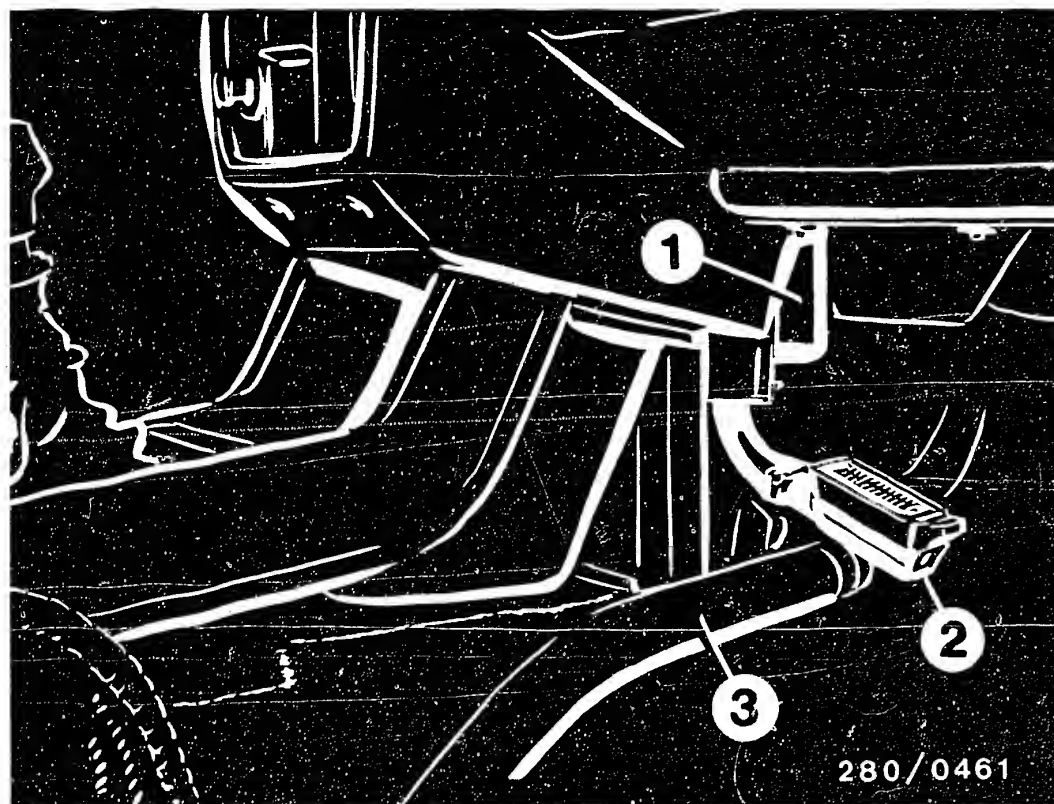
For production reasons:
continued on the following
coordinate.



ELECTRICAL TERMINAL DIAGRAM

B1 = Temperature sensor (engine)
 B2 = Air-flow sensor
 B2/1 = Temperature sensor (air intake)
 B3 = Lambda sensor (heated)
 F1 = Fuse (sensor heater)
 F2 = Fuse (electric fuel pump)
 K1 = Thermo-time switch

K2 = Control relay
 W1 = Ground strap, engine
 X1 = Control-unit plug
 Y1 = Auxiliary-air device
 Y2 = Solenoid-operated injection valve
 Y3 = Starting valve
 Y4 = Electric fuel pump



- 1 = Control unit
- 2 = 25-pin control-unit plug
- 3 = Heating hose for rear-passenger-compartment heating

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

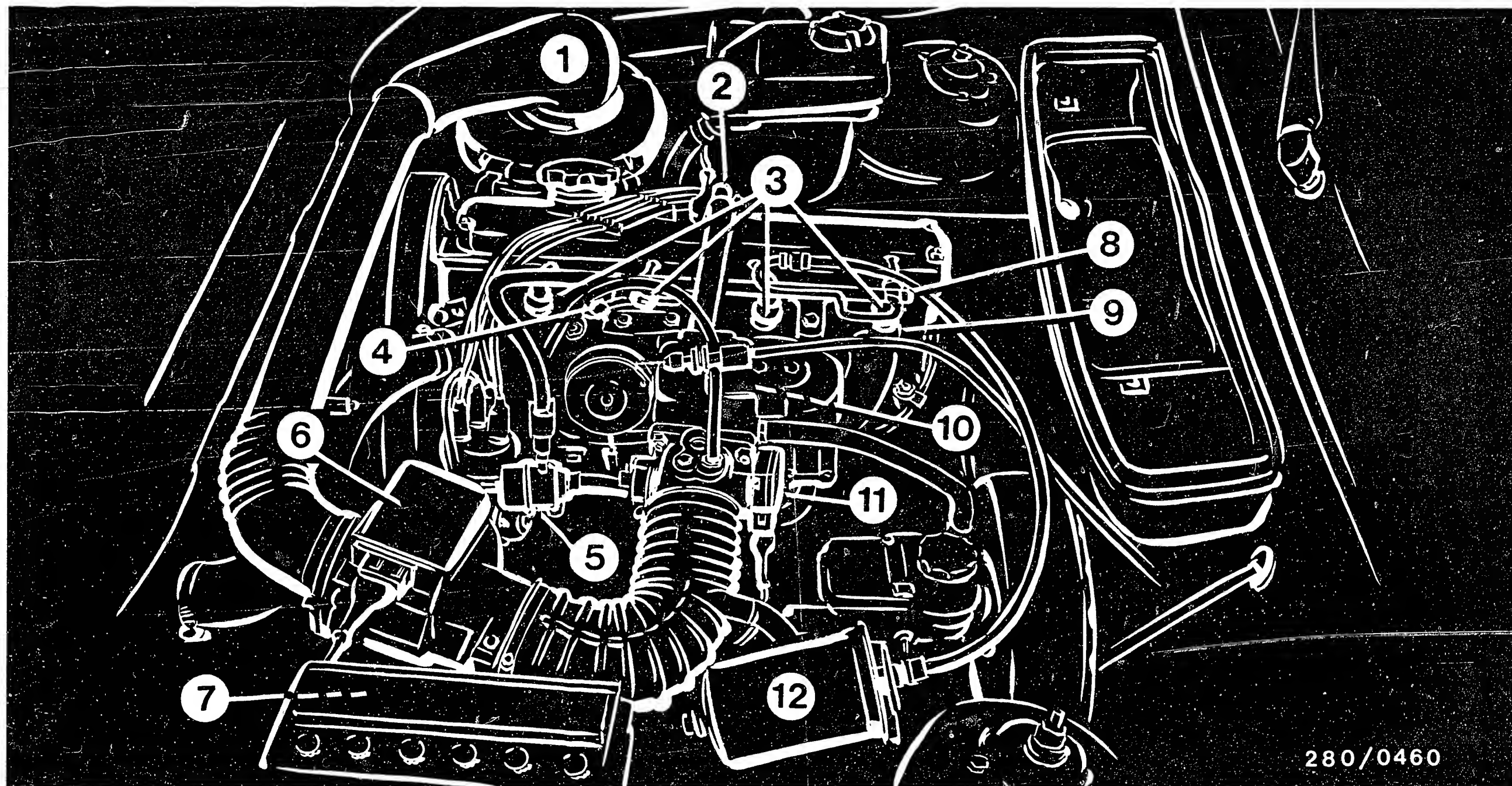
* LU-Jetronic control unit in the passenger compartment.

The control unit is located transversely in the passenger compartment behind the center console.

For testing electrically using the universal test adapter, push open the latch (locking tongue) and disconnect control-unit plug. Connect 25-pin adapter lead to periphery.

To remove the control unit, remove the right-hand and left-hand trim of the center console and disconnect the left-hand heating hose. Loosen the 3 fastening screws from the control unit.

For production reasons:
continued on the following
coord¹nate.



280/0460

* Layout of the components on the engine

1 = Air filter
 2 = Auxiliary-air device
 3 = Solenoid-operated injection valves
 4 = Ground terminal (electronics
 and output stage)

5 = Pressure regulator
 6 = Air-flow sensor
 7 = Control relay
 8 = Thermo-time switch

9 = Temperature sensor (engine)
 10 = Cold-start valve
 11 = Throttle-valve switch
 12 = Fuel filter

Further installation positions of components

- * Electric fuel pump is mounted on a coverplate behind the rear axle.
- * Pump fuse (8A) is on the left in the engine compartment near to the battery.
- * Heated lambda sensor in the exhaust pipe upstream of the catalytic converter.
- * Plug-in connection for sensor signal and sensor heater upstream of the blower/heater box.
- * CO sampling point at the screw plug upstream of the exhaust-gas catalytic converter.

For production reasons:
continued on the following
coordinate.

TABLE OF CONTENTS

Trouble-shooting instructions	: VOL-5002
BOSCH system	: Airbag 2
Make of vehicle	: VOLVO
Basic microcard	: PKW-073

Section	Coordinate
Special features, safety, usage	02
Trouble-shooting chart	04
Self-diagnosis	05
Test specifications	07
Electrical terminal diagram	09
Installation position of components	11

SPECIAL FEATURES

* This microcard contains the airbag trouble-shooting instructions, valid at the time of publication, for the following VOLVO models:

740 (10.86 ->)
760 (10.86 ->)
780 (10.86 ->)

* The airbag triggering device is equipped with self-diagnosis. Should a fault arise in the system, this fault is stored in the fault memory. At the same time, the SRS/RS warning lamp (warning/ diagnostic lamp) lights up in the instrument panel.

* In addition, the time at which the fault arises and the characteristics of the crash are stored in the fault memory. In the case of a court case for damages, these data may be called up by the vehicle manufacturer using a tester.

Caution: When testing the system, use only multimeters with current limitation $\leq 20 \text{ mA}$!

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the airbag system, be sure to observe the safety and precautionary measures in the basic instructions.

* C A U T I O N !

Do not disconnect any plug-in connection of the airbag system when the ignition is switched on and the battery connected. Take measurements only at the plug terminals specified.

When testing the system, use only multimeters with current limitation ≤ 20 mA, since otherwise it is not possible to fully ensure that the airbag will not be triggered by mistake; that is, that the operation of the pellets is altered.

For further precautionary measures, see basic instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. SRS/RS warning lamp lights up constantly
2. SRS/RS warning lamp does not light up when ignition switched on.
3. Interference noise when steering
4. SRS/RS warning lamp lights up intermittently for approx. 10 s. (e.g. after starting)
5. Seat-belt tightener not operating (control unit .. 012 only)

				Cause (component fault)
*	*	*	*	Evaluate self-diagnosis
	*			SRS/RS warning lamp defective
*				Crash stored
		*		Test transmission spring to firing pellet
	*			Test start detection term. 61
*				Fault memory has not been cleared
*	*		*	Test voltage supply
*	*			Test actuating lead to SRS/RS warning lamp
			*	Test seat-belt-tightener wiring circuits

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Component	Cause of trouble	Test instructions	Terminals	Set values
1	Firing circuit and triggering device	Short circuit to pos., ground or triggering dev. defective	Test cable connections for short circuit (current limitation < 20 mA) Replace triggering device.	8 2	1,8...3 Ω
2	Power stand-by Voltage converter	Open circuit or short circuit to ground	Test voltage supply of power stand-by (to do this, disconnect triggering device from wiring harness). Test cable connections for short circuit and open circuit. Replace power stand-by. If fault is not eliminated through installing new power stand-by, replace triggering device.	10 5 4 4	14...16 V > 10 V
3	SRS/RS warning lamp (warning/diagnostic lamp)	Short circuit to ground or to positive	Test cable connections for short circuit, open circuit and loose contact.	3 4	> 10 V
4	Firing circuit, driver's side	Short circuit	Test cable connections for short circuit and open circuit (plug-in connection of airbag and seat-belt-tightener units must be disconnected). Replace wiring harness. Replace airbag or seat-belt-tightener unit.	8 2	1,8...3 Ω
5		Open circuit			
6,7	Triggering device	Incorrect triggering device installed	Install specified triggering device.	—	
8	Firing circuits	Short circuit to positive	Test cable connections for short circuit and open circuit (plugs of airbag and seat-belt-tightener units disconnected).	8 5 2 5	> 1 M Ω > 1 M Ω
9		Short circuit to ground		8 4 2 4	> 1 M Ω > 1 M Ω
10	Triggering device	Mercury switch defective	Replace triggering device. With triggering device (.. 012), test term. 7 for short circuit to ground.		

Note: For all voltage tests, the triggering device (quadruple plug-in connection) must be disconnected first of all.
Before disconnecting any plug-in connection in the airbag system always switch off the ignition and disconnect the battery!

TEST SPECIFICATIONS

Start detection term. 61:

Ignition on: 6 V

Engine running: greater than 10 V

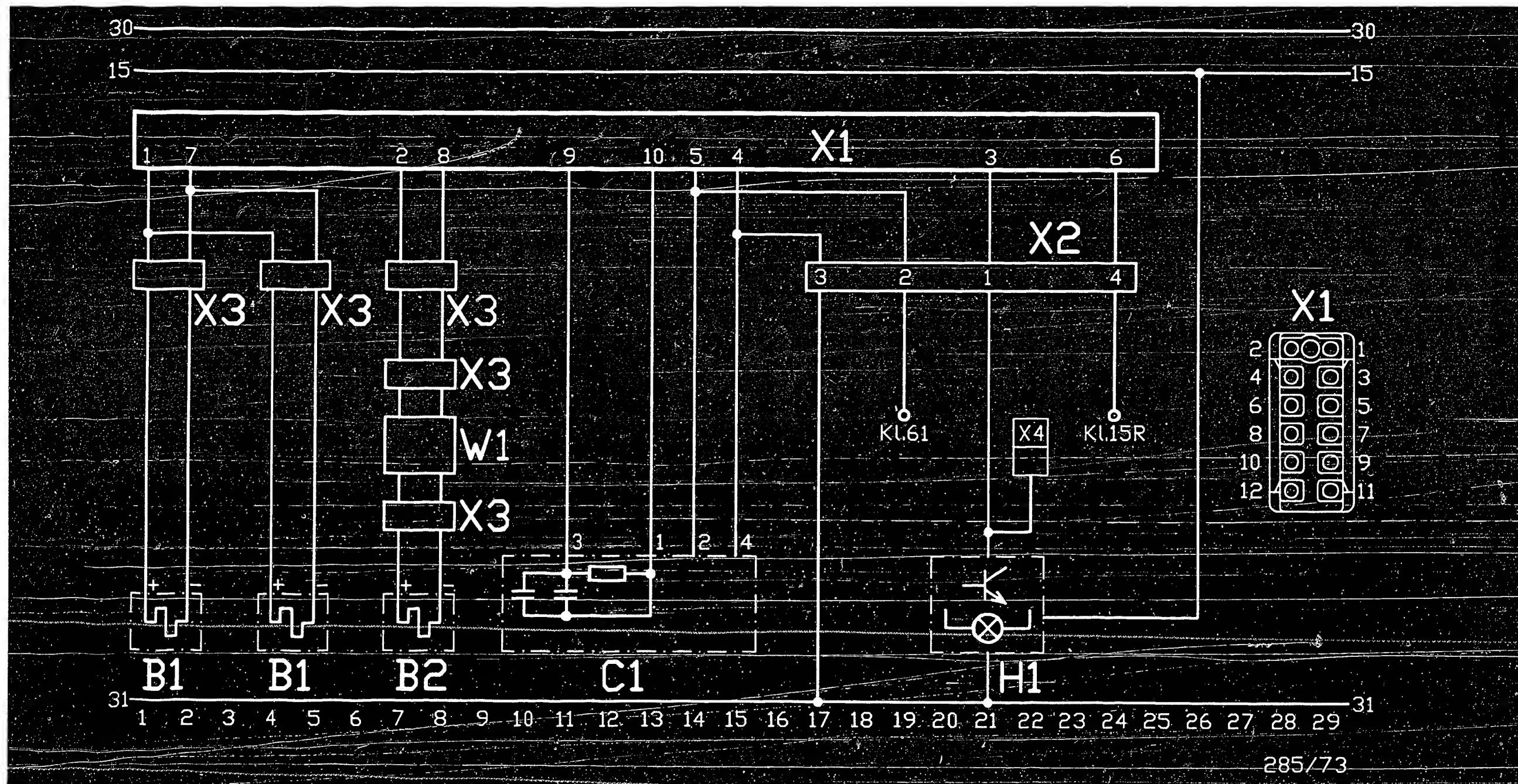
Firing pellets: 1,8...3,0 Ω

Caution: Resistors of the firing circuits
(term. 8, term. 2, term. 1, term. 7)
must be tested only with a multi-
meter with current limitation
< 20 mA (airbag may be
triggered or firing
characteristic of the
firing pellets is
altered).

Tightening torque of the fastening screws
of the triggering device: 8,1 Nm

of the triggering unit: 9,9 Nm

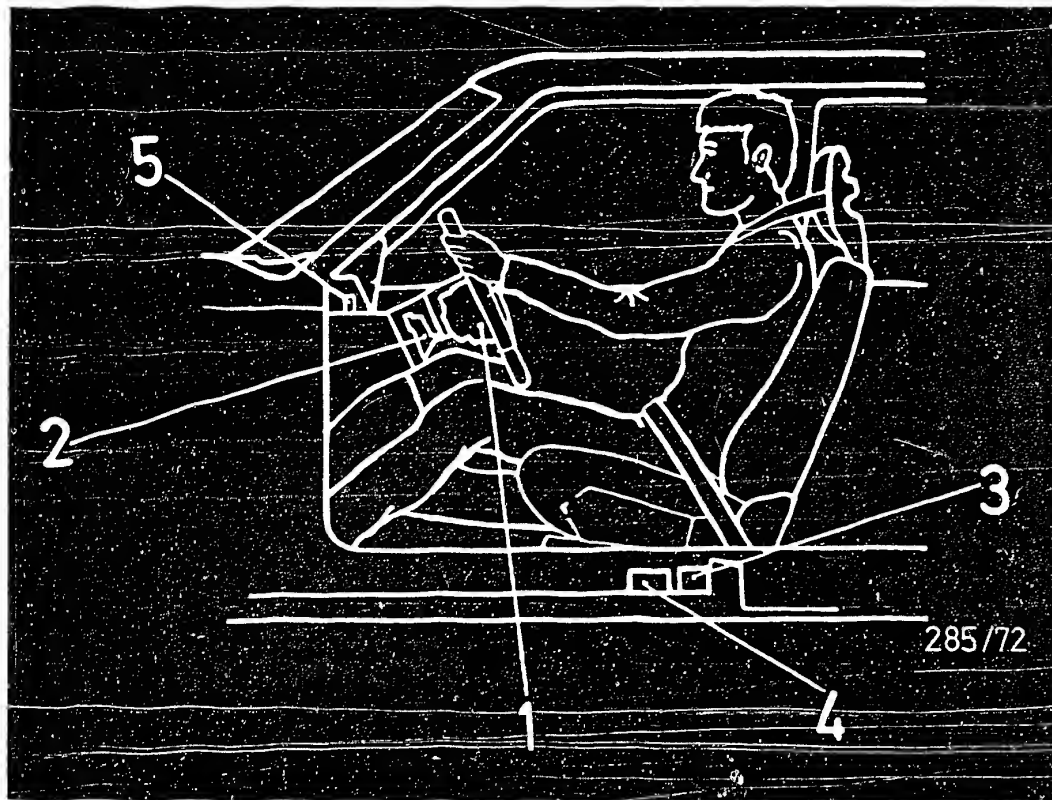
For production reasons:
continued on the following
coordinate.



B1 = Firing pellet of airbag unit
 B2 = Firing pellets of seat-belt tightener units (Type 780)
 C1 = Power stand-by with voltage converter
 H1 = SRS/RS warning lamp with lamp driver
 W1 = Volute spring (contact roller)

X1 = Triggering device
 X2 = Quadruple plug-in connection
 X3 = Double plug-in connection
 X4 = Stimulus lead (to central electrics)

ELECTRICAL TERMINAL DIAGRAM



- 1 = Airbag unit
- 2 = Transmission spring (contact roller)
- 3 = Triggering device
- 4 = Power stand-by and voltage converter
- 5 = SRS/RS warning lamp

INSTALLATION POSITION OF COMPONENTS

For production reasons:
continued on the following
coordinate.

Trouble-shooting instructions: OPE-5008

BOSCH system : Electronic transmission control (GS)

Vehicle make : OPEL

Basic microcard : BMW-00/E121

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Self-diagnosis test table.....	07
Test specifications.....	15
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Installation position of components, Notes on removal and installation.....	19

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

- * Opel Senator-B with 3.0 l / 6 cyl. as of 9.87.
- * Electronic transmission control GS 3.1 (25 pole) with self-diagnosis and flashing-code output.
- * Control-unit no.: with ABS 0 260 002 012
without ABS 0 260 002 013
as of 02.88 with/without ABS 0 260 002 063
- * Possibility of switching from "economy" to sporty gear-shift program with program button (with engine running in pos. "D" and "2").
Return to "economy" program by pressing program button again.
- * Starting aid (starting in 3rd gear) on smooth road surface by actuating winter button (with engine running in pos. "D"; indicator lamp for winter button lights up).
Exit from "winter program" by pressing button again or automatic (speed, load and time-dependent).

F a u l t l a m p :

The instrument panel features a fault lamp (gear symbol). It has the following function: transmission indicator lamp, flashing-code display for self-diagnosis and indication of sporty program. It lights up when the ignition is switched on and goes out once the engine has been started.

A flashing fault lamp indicates a fault and limp-home program (continue driving in 3rd gear or in 4th gear with control unit ...063) with selector lever in position "D".

Important!

With the limp-home program it is possible to manually select a lower driving position irrespective of speed (shift-back safeguard in control unit not active).

When shifting back, there is thus a danger of overrevving the engine and/or of destroying the transmission coupled with an accident risk.

Continue trouble-shooting with engine control system if no fault is found in the transmission control.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Transmission oil:

With automatic transmissions, even slight deviations from the specified oil level or incorrect grade of oil can lead to a noticeable deterioration in the quality of shifting. Major deviations may even result in incorrect shifting.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Fault lamp flashes.
2. Engine fails to start.
3. Engine stalls with drive mode selected.
4. No gear-shifting or gear-shifting not correct.
5. Gear shifts not smooth.
6. No full-load gear shifts.
7. Only full-load gear shifts.
8. No sport program.
9. Winter-mode button not functioning
10. Jerk when shifting into reverse gear.
11. Reverse gear cannot be selected.

Cause (component fault)											
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
	*										Relay set defective
		*									Voltage at transm. control unit
		*	*								Throttle-valve sensor
	*	*									Ground terminal open circuit / contact resistance
		*	*								Connection for solenoid-operated valves on transmission
	*										Starting disable relay
	*	*	*								Position switch
						*					Program button
							*				Winter-mode button
		*									Idle contact
		*									Idle actuator
		*									Idle speed
			*								No engine action
				*							No kickdown contact
					*						Kickdown constantly to ground
		*	*								Solenoid-operated valve(s)
		*									Travel pulse generator
	*										Converter clutch not releasing
		*	*								Interference
*		*	*	*	*	*	*	*	*	*	Electronic control unit defective
	*	*	*					*	*		Transmission defective

ACTIVATING THE SELF-DIAGNOSIS:

The diagnostic plug is located in the engine compartment on the right-hand side.

Switch on ignition and leave engine running.

Disconnect protective diagnostic plug.

Connect sockets A (ground) and C (upper illustration) to lead.

Fault lamp in instrument panel start to flash.

Evaluating the flashing code:

The flashing code for each fault consists of two flashing-pulse blocks. Each block represents a number and consists of 1 to 9 pulses. One pulse corresponds to the number 1, 9 pulses correspond to the number 9. With each pulse, the fault lamp lights up fly. There is a longer pause between the blocks than there is between the individual pulses. There is an even longer pause (approx. 3 seconds) between two fault codes.

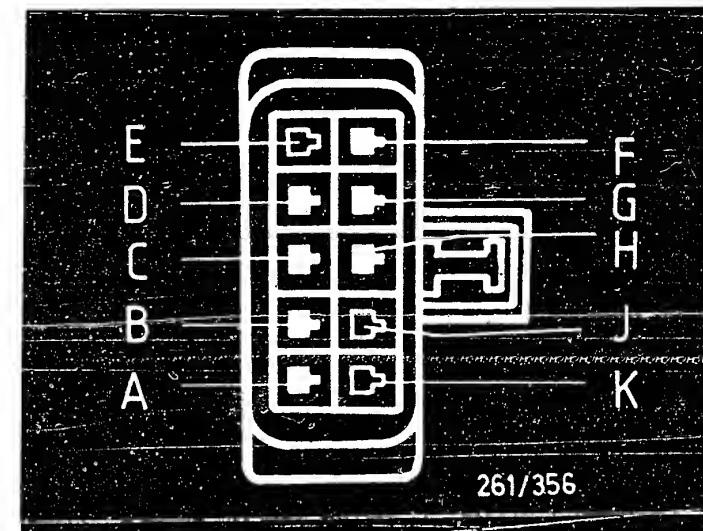
Each time diagnosis is output, this procedure always begins with the starting code 1 2. This flashing code is repeated at least 3 times. It indicates that the diagnostic output is working. If there is no fault stored in the control unit, the flashing code 1 2 is repeated constantly.

If a fault is stored in the control unit, after the flashing code 1 2, the first fault is output 3 times. If a further fault is stored, its flashing code follows likewise 3 times

Up to a max. of 5 faults may be stored. After the last fault has been output, the flashing code starts again with 1 2, etc.

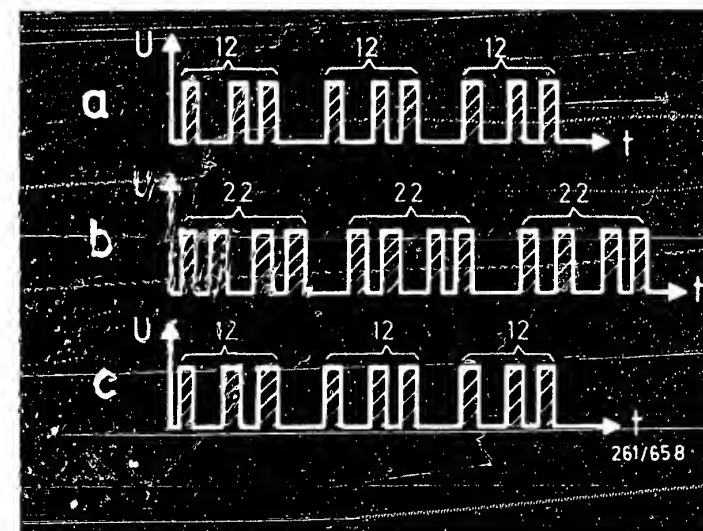
Diagnosis output is terminated by pulling apart the connection at the diagnostic plug or by switching off the ignition.

The fault memory in the control unit is cleared if the battery or the electronic control unit is disconnected for at least 10 seconds or if the ignition is switched on and off more than 20 times.



Top view of diagnostic plug

a = c = Flashing code 1 - 2
b = Fault code 2 - 2
Shaded pulse area =
Fault lamp lit



SELF-DIAGNOSIS TEST TABLE

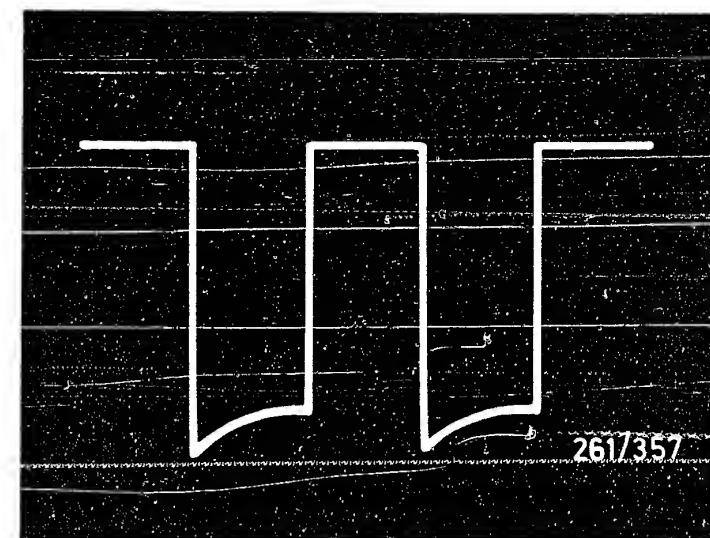
Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
1 2	Control unit/flashing-code output O.K.	Flashing-code output does not function if fault lamp, leads to fault lamp and stimulus lead or power supply to control unit defective. Control unit is defective if everything is O.K., but no flashing code is output.	4, 16	—
1 7	Solenoid valve 1 / short-circuit to ground	Check solenoid valve and lead for short-circuit to ground. Watch out for worn cable insulation!	14	—
1 8	Solenoid valve 1 / cross-connection to solenoid valve 2	Check lead for short-circuit with lead of solenoid valve 2. Watch out for worn cable insulation!	14, 15	—
1 9	Solenoid valve 1 / cross-connection to solenoid valve - transformer coupling	Check lead for short-circuit with lead of solenoid valve - transformer coupling. Watch out for worn cable insulation!	14, 17	—
2 1	Throttle-valve potentiometer Throttle-valve angle	Fault: throttle-valve-sensor signal on stop Possible causes: wiper lead short-circuited with positive lead of sensor or open-circuit in ground lead. Potentiometer defective. Watch out for worn cable insulation!	24, 23 11	Voltage supply of sensor (term.1 and term.2): greater than 4,5 V Wiper voltage (term.3 and term.2) with throttle valve closed 0,45...0,75 V
2 2	Throttle-valve potentiometer Throttle-valve angle	Fault: no throttle-valve-sensor signal (potentiometer wiper) Possible causes: open-circuit in wiper lead, short-circuited with ground or open-circuit in positive lead of sensor. Potentiometer defective. Watch out for worn cable insulation!	24 23	Slowly open throttle as far as it will go: Voltage increases without dips to min. 4,2 V

SELF-DIAGNOSIS TEST TABLE (continued)

Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
2 4	Position pulse generator (Hall generator)	Fault: failure of signal. Check generator and leads (including voltage supply of generator). Signal of position pulse generator:	25	Rectangular signal
2 5	Solenoid valve 1 / short-circuit with respect to UB or open-circuit	Check lead for short-circuit with respect to UB or open-circuit. Watch out for worn cable insulation! Resistance of solenoid-valve winding:	14	8...20 Ω
2 6	Solenoid valve 2 / short-circuit to ground	Check solenoid valve and lead for short-circuit to ground. Watch out for worn cable insulation!	15	—
2 7	Solenoid valve 2 / cross-connection to solenoid valve - transformer coupling	Check lead for short-circuit with lead of solenoid valve - transformer coupling. Watch out for worn cable insulation!	15, 17	—
2 8	Solenoid valve 2 / short-circuit with respect to UB or open-circuit	Check lead for short-circuit with respect to UB or open-circuit. Watch out for worn cable insulation! Resistance of solenoid-valve winding:	15	8...20 Ω
2 9	Solenoid valve - transformer coupling/ short-circuit to ground	Check lead for short-circuit to ground. Watch out for worn cable insulation!	17	—

SELF-DIAGNOSIS TEST TABLE (Continued)

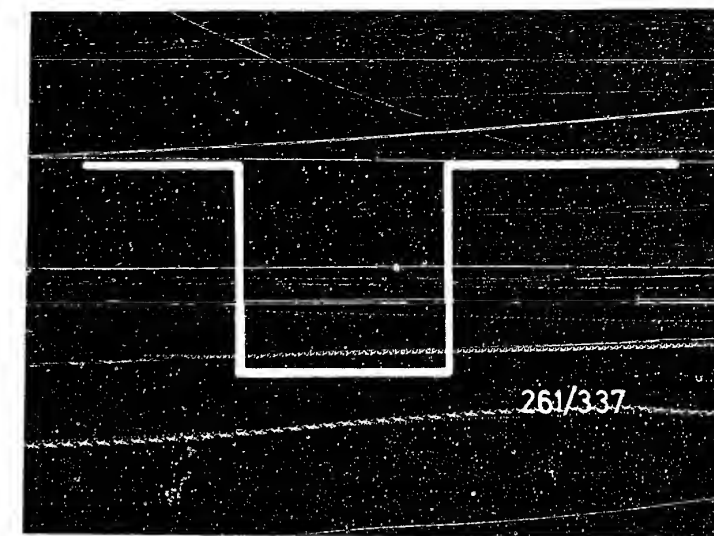
Fault indication Flashing code	Testing of component/function Test instructions/conditions	Terminals	Set values
3 1	<p>TD signal (engine speed) from the Motronic (without Cat: from the ignition)</p> <p>Fault: interruption of signal. Trouble-shooting: check lead from term. 19 to Motronic control unit term. 21 (without Cat: spark-advance mechanism term. 5).</p> <p>Source of signal (Motronic control unit or spark-advance mechanism) O.K.?</p>	19	TD signal with engine running (Upper illustration)
3 6	<p>Converter-clutch solenoid-operated valve</p> <p>Check lead for short circuit to batt.+ve or open circuit.</p> <p>Resistance of solenoid-operated-valve winding:</p>	17	8...20 Ω
4 6	<p>Shifting down from 3 to 2 had to be prevented by control unit due to incorrect or missing drive-speed information.</p> <p>Most frequent cause of trouble: lead(s) between travel pulse generator and control unit open-circuited.</p>	—	—
4 7	<p>As for flashing code 4 6, however, applies to shifting down from 4 to 2.</p>	—	—
5 5	Control unit (digital part) defective	—	—
5 6	Position switch defective or supply line open-circuited (control unit term. 9 to position switch, Pos. D).	9	—



TD signal

SELF-DIAGNOSIS TEST TABLE (Continued)

Fault indication Flashing code	Testing of component/function Test instructions/conditions	Terminals	Set values
7 5	Engine action. Lead to Motronic control unit term. 8 (without Cat: spark-advance mechanism term. 8) open-circuited or short- circuited to ground.	18	Rectangular signal when shifting (upper illustration)
7 7	Kickdown switch. Fault: Switch constantly closed. Check lead for short circuit to ground.	20	—
7 8	Slipping-time monitoring. Fault: Slipping time too long when shifting up from first into second or from second into third gear. Cause: defective transmission or engine action not O.K.	—	—



Engine-action signal

TEST SPECIFICATIONS

The test specifications stated apply to measurements taken directly at the component or at the 25-pin plug.

Voltage supply for travel
pulse generator (Hall generator): Greater than 10 V

Solenoid-op. valves (in transm.)
MV-1, MV-2, MV-WK (converter clutch)
Resistance to ground, each: 8...20 Ω

Kickdown switch actuated
Resistance to ground: Approx. 0 Ω

Position switch in position
1, 2, D, N :
each time battery voltage to the corresponding control-unit-plug terminals with ignition switched on.

Program button (in selection lever) actuated
Term. 7 in control-unit plug;
resistance to ground: Approx. 0 Ω

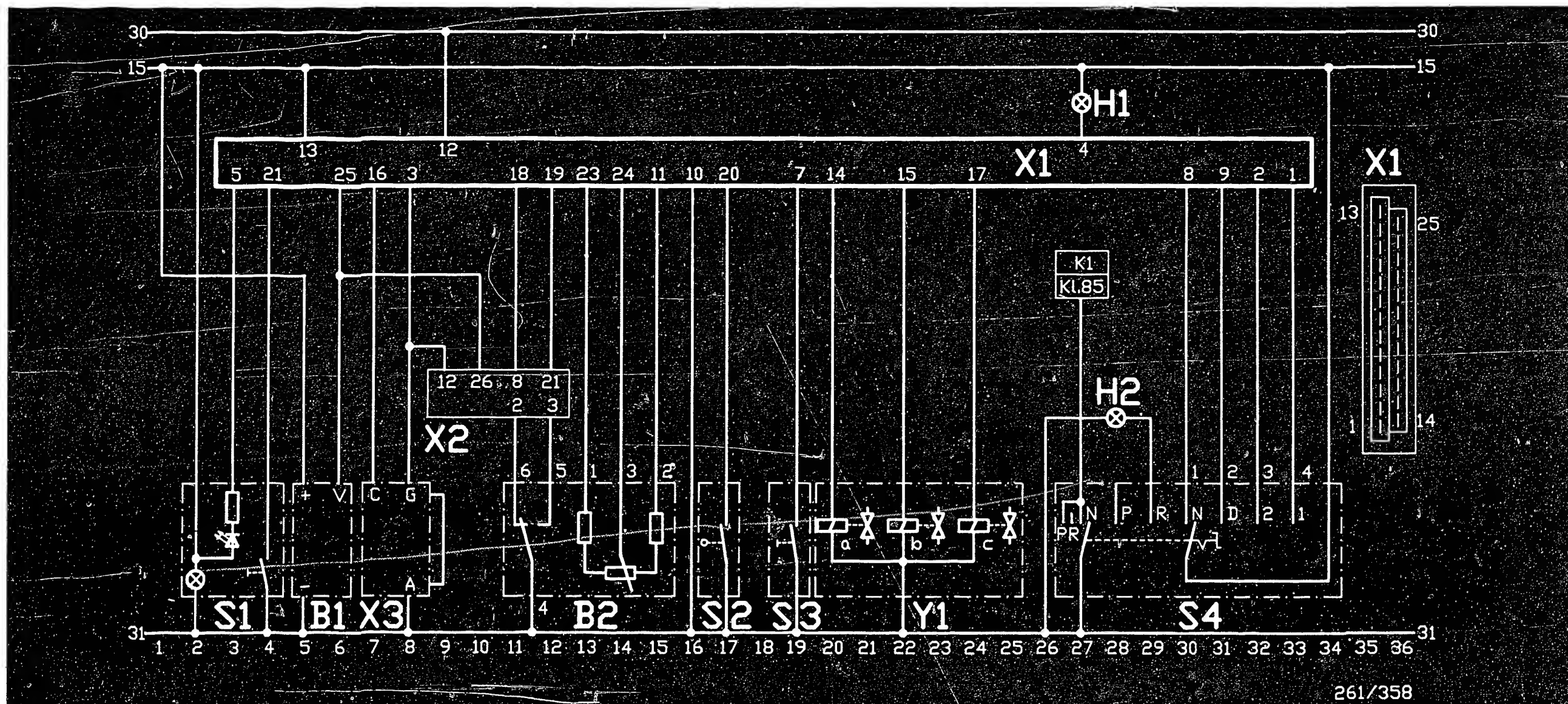
Winter-mode button actuated
Term. 21 in control-unit plug;
resistance to ground: Approx. 0 Ω

Throttle-valve potentiometer

Total resistance between
pin 1 and pin 2 : 3...5 k Ω

Wiper resistance between
pin 3 and pin 2
(potentiometer at idle
stop): 250...800 Ω

For production reasons:
continued on the following
coordinate.



B1 = Travel pulse generator
 B2 = Throttle-valve sensor
 H1 = Fault lamp
 H2 = Backup lamp
 K1 = Starting disable relay
 S1 = Winter-mode button with indic. lamp
 S2 = Kickdown switch

S3 = Program button
 S4 = Position switch
 X1 = Electronic-control-unit plug
 X2 = Motronic control-unit plug
 X3 = Self-diagnosis plug
 Y1 = Transm. unit with switching valves

a = Solenoid-operated valve 1
 b = Solenoid-operated valve 2
 c = Converter-clutch solenoid-operated valve

ELECTRICAL TERMINAL DIAGRAM

INSTALLATION POSITION OF COMPONENTS

Control unit for electronic transmission control:

In the engine compartment between the right-hand McPherson-strut dome and firewall (upper illustration, arrow)

Solenoid-operated valves for gear-shifting and converter clutch:

In the transmission

Connection for solenoid-operated valves:

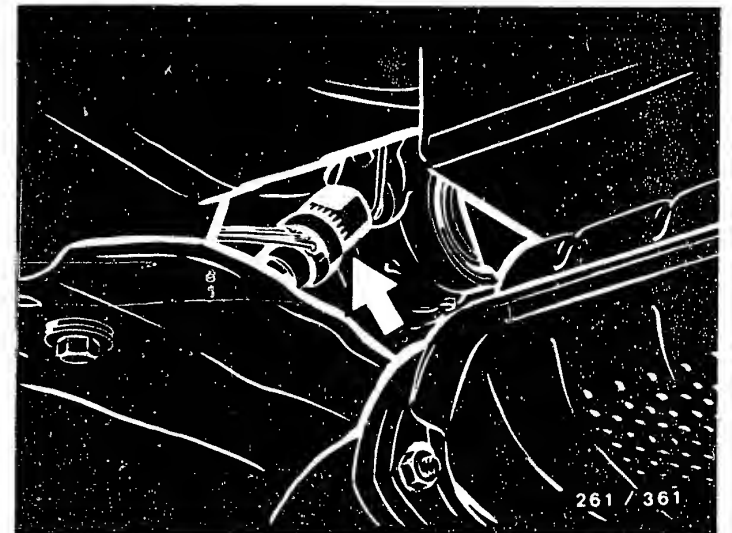
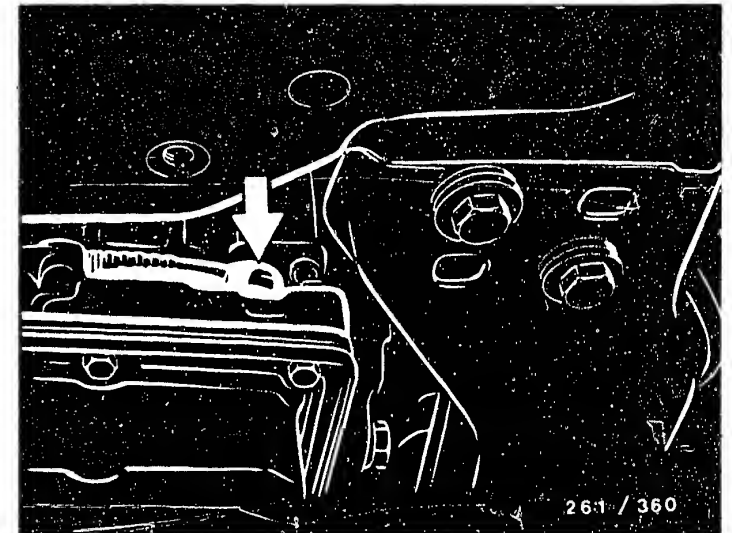
On the transmission on the left (center illustration, arrow)

Travel pulse generator:

At transmission output (lower illustration,)

Kickdown switch:

Under accelerator pedal



INSTALLATION POSITION OF COMPONENTS (Continued)

Position switch:

On control console (upper illustration, Item 1)

Winter-mode button with indicator lamp:

On control console (upper illustration, Item 2 and Item 3)

Program button:

On the selection lever (upper illustration, Item 4)

See upper illustration: 1 = Position switch with selection lever
2 = Winter-mode button
3 = Indicator lamp for winter-mode button
4 = Program button

Fault lamp:

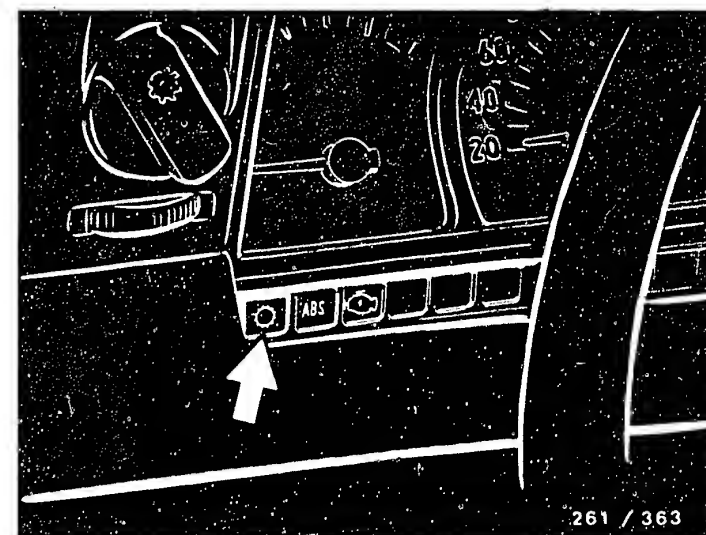
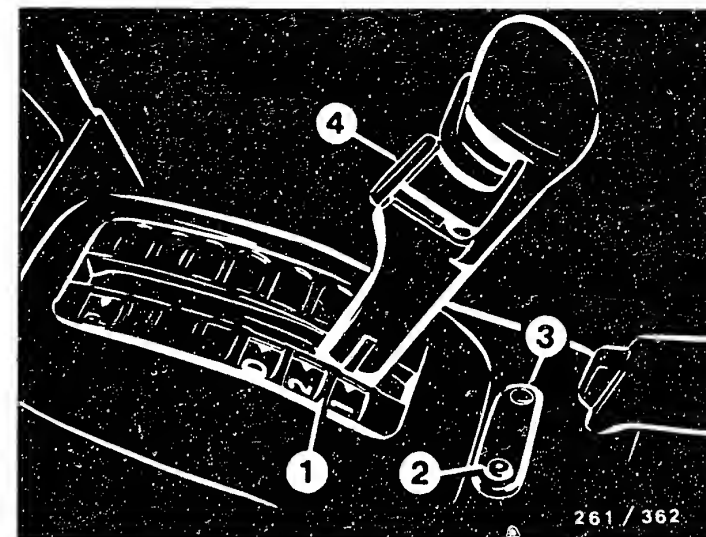
In the instrument-lamp strip (toothed-gear symbol)
(center illustration, arrow)

Throttle-valve sensor:

On the throttle-valve assembly (lower illustration, arrow)

N O T E:

Adjust by means of the idle contact and then check voltage at plug
between term. 3 and term. 2 - switch on
ignition; accelerator pedal in rest position: 0.45...0.75 V
accelerator pedal pushed to floor: greater than 4.20 V



INSTALLATION POSITION OF COMPONENTS (Continued)

Diagnostic plug:

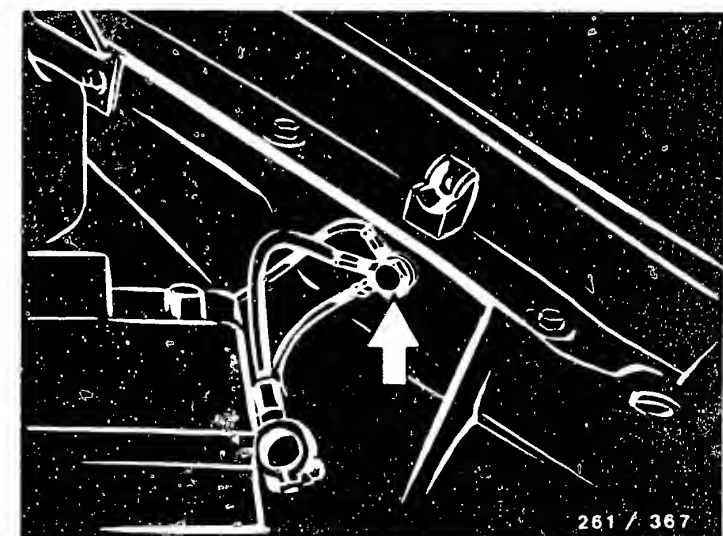
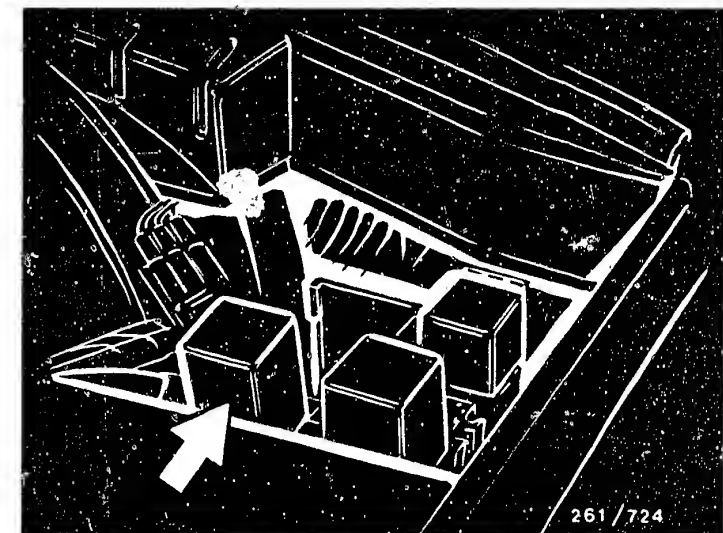
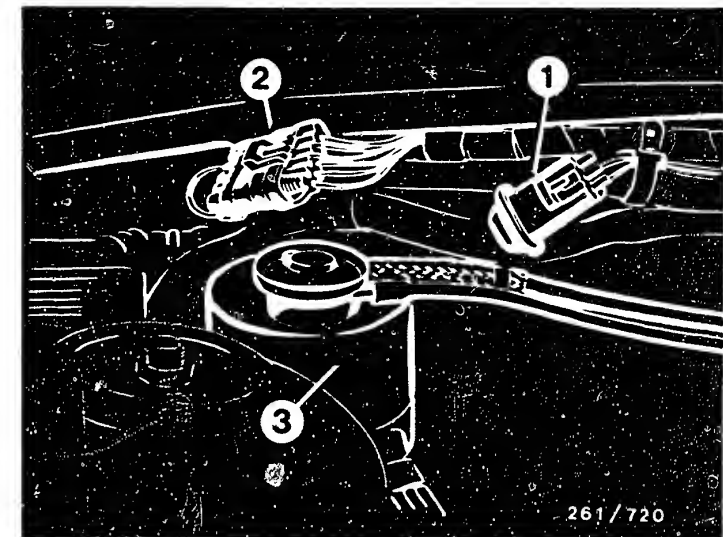
Near to the electronic control unit (upper illustration, Item 2)

Relay set for transmission control and Motronic:

In the engine compartment between the left-hand McPherson-strut dome and the firewall (center illustration, arrow)

Ground terminal:

Next to the battery (lower illustration, arrow)



Trouble-shooting instructions: BMW-5008

BOSCH system : Electronic transmission control (GS)

Vehicle make : BMW

Basic microcard : BMW-528

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SPECIAL FEATURES

These trouble-shooting instructions apply to the following vehicle models valid at the time of printing:

- * BMW 735i with 3.5 l / 6 cyl. as of 10.86
- BMW 730i with 3.0 l / 6 cyl. as of 1.87
- BMW 750i with 5.0 l / 12 cyl. as of 8.87
- * Electronic transmission control GS 1.2 with self-diagnosis and flashing-code output (no test with universal test adapter).
- * Control unit with 35-pin plug.
- * EML interface (no throttle-valve potentiometer in vehicle version with electric-motor power control; the information on throttle-valve position comes from EML control unit).
- * Adaptive pressure control.
Operating principle:
 - Monitoring of shift times by compensation for disturbance variables such as change in friction coefficient in the multi-plate clutches, tolerances of actuators or declining engine power output.
 - Actual/target comparison of shift times.
 - Storage of correction values (non-volatile memory with continuous power supply).

If no fault is found in the transmission control, continue trouble-shooting with the Motronic.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Transmission oil:

With automatic transmissions, even slight deviations from the specified oil level or incorrect grade of oil can lead to a noticeable deterioration in the quality of shifting. Major deviations may even result in incorrect shifting.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Fault message "Transmission" in check control.
2. Engine fails to start.
3. Engine stalls in drive position.
4. No shifting or shifting incorrect.
5. Poor transitions when shifting.
6. No full-load shifting
7. Full-load shifting only
8. Manual downshifts not O.K.
9. Hard jolt when selecting reverse gear
10. Reverse gear not selectable

Cause (component fault)									
*	*	*	*	*	*	*	*	*	Self-diagnosis
*	*								Main relay defective
*									Voltage at GS control unit
		*	*						Throttle-valve sensor
	*	*							Open circuit or contact resistance at ground terminal
*		*							Plug dropped off transmission or defective
	*								Starting-interlock relay
	*		*	*					Selector switch
		*	*		*				Program switch
		*							Idle contact
		*							Idle actuator
		*							Idle speed
				*					No kick-down contact
					*				Kick-down constantly grounded
*			*			*			Pressure regulator
			*						No engine-torque reduction
		*	*						Solenoid-operated valve(s)
		*							RPM sensor
	*								Converter clutch not releasing
			*						Interference
*		*	*	*	*	*	*	*	GS control unit defective

HOW TO ACTIVATE THE SELF-DIAGNOSIS

Connecting the fault lamp.

To read out the flashing code, connect a fault lamp between terminal 20 of the diagnosis socket and positive battery

terminal (Service tool KDAW 9980: Sockets 1 (positive) and 2).

How to activate the self-diagnosis.

With ignition off and vehicle stationary, select drive range 1. Switch on ignition and, within 20 seconds, input the following program sequence with the program switch:

S program
E program
S program

Evaluating the flashing code.

The fault output starts with a start pulse of 2,5 sec. duration. After the start pulse, the first stored fault is output.

This fault is repeated continuously with a pause of 2,5 seconds in between.

When the system is interrogated again by inputting the program sequence

E program
S program

the next fault is output etc.

There may be a maximum of 5 faults stored.

The flashing code for each fault consists of 4 flashing-pulse blocks. Each block represents a digit and contains 1 to 4 pulses. One pulse corresponds to the digit 1, 4 pulses correspond to the digit 4. With each pulse, the fault lamp lights up briefly. Between the blocks there is a longer pause than between the individual pulses.

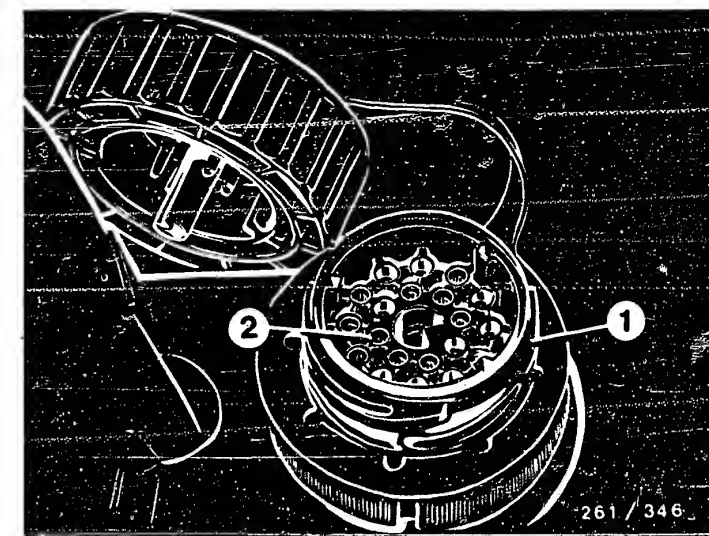
Note:

If there is no or no further fault stored, the flashing code 0 0 0 0

(longer pulses of 2,5 seconds duration) or, in the case of vehicles as of FD 652, the flashing code 4 4 4 4 appears.

Clearing the fault memory.

After the faults that have been output have been rectified, clear the fault memory. To do this, disconnect the control unit or the negative pole of the battery for a few minutes.



1 = Diagnosis socket

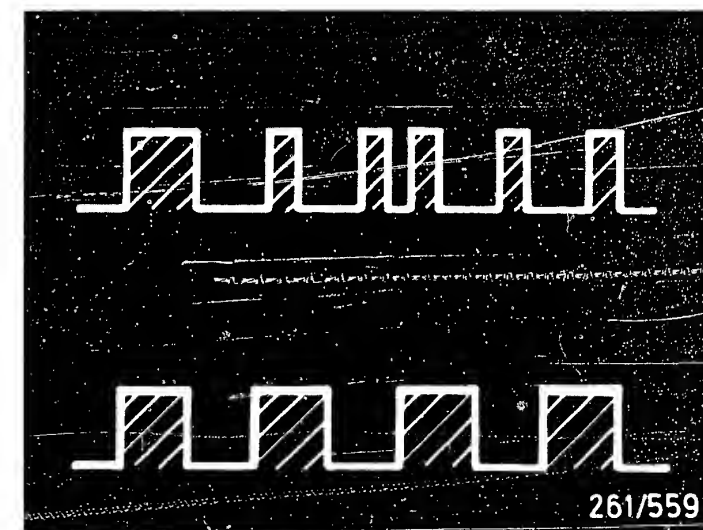
2 = Terminal no. 20

a = Fault code 1 2 1 1

b = Flashing code 0 0 0 0

(No fault stored)

Shaded pulse area =
Fault lamp lit

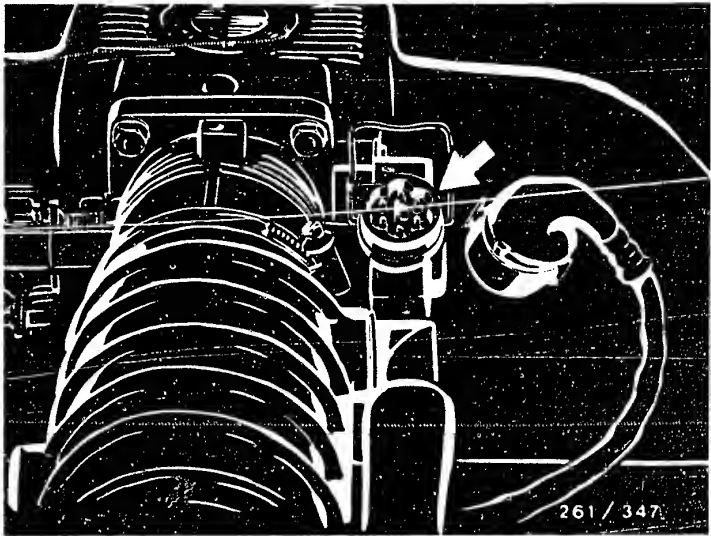


SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Termi- nals	Set values
1 3 1 1	Control unit for transmission control	Check voltage supply for control unit for transmission control	35, 34 (+) 5, 19 (-)	10...15 V
1 1 2 1	Kick-down switch (KD switch)	Fault: KD switch permanently closed. KD switch closed in full-throttle position: Release accelerator pedal somewhat:	2, ground	Approx. 0 Ω Infinity Ω
1 1 2 2	Program button	Fault: Program indication does not change despite actuation of program button. Test: Test corresponding lead between program button and control unit for transmission control for short-circuit to ground. Indication const. on "S", lead 6 to term. 4. Indication const. on "E", lead 1 to term. 14. Indication const. on "M", lead 2 to term. 15. Note: If leads are O.K., continue trouble-shooting in program button itself (permanently grounded), or program indication /control unit for transmission control defective.	4, 14 15 6 (-)	—

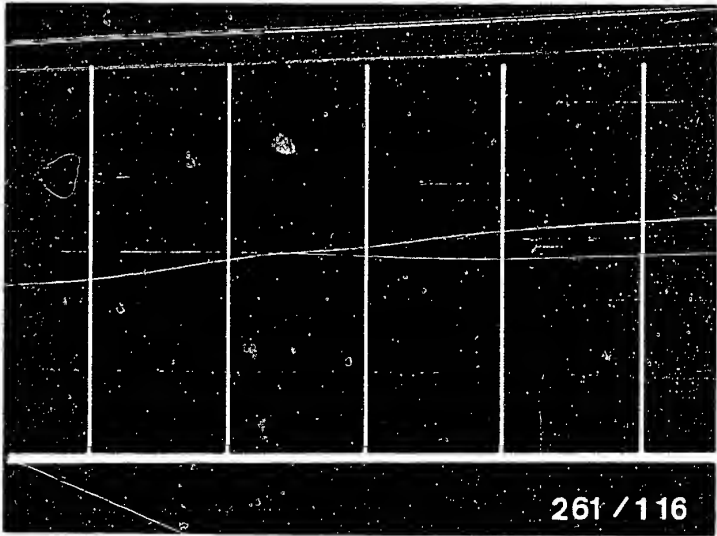
SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Checking of component/function Test instructions/test conditions	Termin- als	Set values
1 1 2 3	<p>Fault: Throttle-valve signal (throttle-valve angle from throttle-valve potentiometer) With electronic accelerator, signal from electronic-accelerator control unit.</p> <p>Possible causes (without electronic accelerator): Wiper lead/positive lead of throttle-valve potentiometer has open circuit or short circuit to ground. Potentiometer defective.</p> <p>Possible causes (with electronic accelerator): Corresponding lead from electronic-accelerator control unit to electronic-transmission control unit has open circuit or short circuit to ground or to battery voltage. Watch for worn insulation on leads.</p> <p>Resistance of throttle-valve potentiometer (pins 1,2) :</p> <p>Resistance at wiper (pins 3,2) with throttle valve closed : Slowly open throttle :</p>	<p>9. 6</p> <p>7. 6 7. 6</p>	<p>3...5 k Ω</p> <p>250...800 Ω Resistance rises continuously.</p>
1 1 3 1	<p>Fault: No Tr signal from Motronic</p> <p>Possible causes: Lead between electronic-transmission control unit term. 21 and Motronic control unit term. 3 has open circuit or short circuit to ground or to battery voltage.</p>	21	See bottom picture for signal



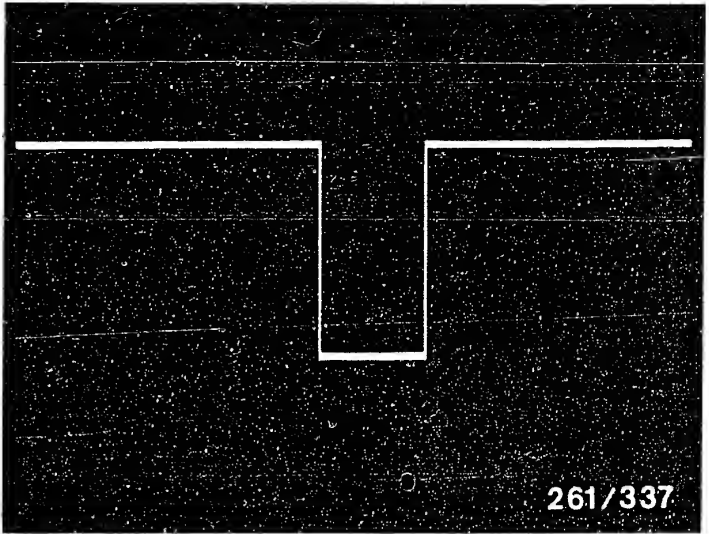
Arrow = Throttle-valve potentiometer

T_r signal
(Engine speed)



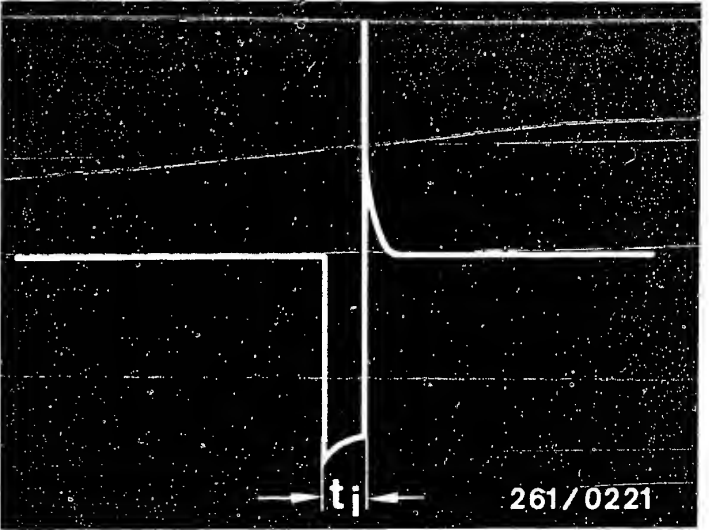
SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Checking of component/function Test instructions/test conditions	Termin- als	Set values
1 1 3 2	Fault: No/permanent engine-torque reduction Possible causes: Lead between electronic-transmission control unit term. 24 and Motronic control unit term. 51 has open circuit or short circuit to ground.	24	
1 1 3 3	Fault: No Ti signal Possible causes: Lead between electronic-transmission control unit term. 11 and Motronic control unit term. 32 has open circuit or short circuit to ground or positive	11	
1 2 1 1	Check solenoid-operated valve 1 and lead for short circuit to ground, to positive or for open circuit. Watch for worn insulation on leads. Resistance of solenoid-operated-valve winding:	16	22...60 Ω
1 2 1 2	Check solenoid-operated valve 2 and lead for short circuit to ground, to positive or for open circuit. Watch for worn insulation on leads. Resistance of solenoid-operated-valve winding:	17	22...60 Ω



Engine-action signal

Injection signal
 t_i = Duration of injection



SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Checking of component/function	Test instructions/test conditions	Terminals	Set values
1 2 1 3	Solenoid-operated valves MV-1 and MV-2	Check leads of both valves for short circuit between one another. Watch for worn insulation on leads.	16, 17	—
1 2 1 4	Solenoid-operated valve for reverse-gear lock (MV-R)	Check solenoid-operated valve and lead for short circuit to ground (no reverse gear), to positive or for open circuit. Watch for worn insulation on lead. Resistance of solenoid-operated-valve winding :	20	22...60 Ω
1 2 2 1	Solenoid-operated valves MV-1 and MV-R	Check leads of both valves for short circuit between one another. Watch for worn insulation on leads.	16, 20	—
1 2 2 2	Solenoid-operated valves MV-2 and MV-R	Check leads of both valves for short circuit between one another. Watch for worn insulation on leads.	17, 20	—
1 2 2 3	Solenoid-operated valves MV-1, MV-2 and MV-R	Check leads of the three valves for short circuit between one another. Watch for worn insulation on leads.	16, 17 20	—
1 2 2 4	Solenoid-operated valve for converter clutch (MV-WK)	Check solenoid-operated valve and lead for short circuit to ground, to positive or for open circuit. Watch for worn insulation on lead. Resistance of solenoid-operated-valve winding:	25	22...60 Ω

SELF-DIAGNOSIS TEST TABLE (continued)

Fault indication Flashing code	Checking of component/function	Test instructions/test conditions	Terminals	Set values
1 2 3 1	Solenoid-operated valves MV-1 and MV-WK	Check leads of both valves for short circuit between one another.	16, 25	_____
1 2 3 2	Solenoid-operated valves MV-2 and MV-WK	Check leads of both valves for short circuit between one another.	17, 25	_____
1 2 3 3	Solenoid-operated valves MV-1, MV-2 and MV-WK	Check leads of the three valves for short circuit between one another.	16, 17, 25	_____
1 2 3 4	Solenoid-operated valves MV-R and MV-WK	Check leads of both valves for short circuit between one another.	20, 25	_____
1 2 4 1	Solenoid-operated valves MV-1, MV-R and MV-WK	Check leads of the three valves for short circuit between one another.	16, 20, 25	_____
1 2 4 2	Solenoid-operated valves MV-2, MV-R and MV-WK	Check leads of the three valves for short circuit between one another.	17, 20, 25	_____
1 2 4 3	Power supply (positive) to solenoid-operated valves and pressure regulator	Disconnect plug connector from transmission; switch on ignition; measure voltage at plug (see installation position of components): If no voltage, check lead to control unit term. 1 for continuity, loose contact or short circuit to ground.	1	Battery voltage

SELF-DIAGNOSIS TEST TABLE (continued)

Fault indication Flashing code	Checking of component/function	Test instructions/test conditions	Terminals	Set values
1 2 4 4	Pressure regulator	Check pressure regulator and lead for short circuit to ground, to positive or for open circuit. Watch for worn insulation on lead. Consequences: Control unit activates the emergency program Resistance of pressure regulator:	22	1,7...4,5 Ω
1 4 1 1	RPM sensor/downshift safeguard	Fault: Signal failure. Check sensor leads (to term. 8 and 27 of electronic transmission control unit). Resistance of RPM sensor:	8, 27 (23)	0,7...1,8 k Ω
1 4 1 2	Control unit/ overrevving safeguard	Fault: Engine has been overrevved or Tr signal incorrect or not plausible. Clear fault and perform road test. If fault message repeated, check lead to Motronic term. 3 (also pump relay term. 85) for loose contacts. Watch for worn insulation on leads. Check Tr signal at Motronic control unit (term. 3) with oscilloscope. Incorrect signal points to a fault in the Motronic.	21	Correct Tr signal
1 4 1 3	RPM sensor/stall-speed monitoring	As for flashing code 1 4 1 1	8, 27 (23)	

TEST SPECIFICATIONS

The stated test specifications apply to measurements directly at the component or at the 35-pin plug without test adapter connected.

RPM sensor (in transmission): 0,7...1,8 k Ω

Pressure regulator (in transm.): 1,7...4,5 Ω

Solenoid-operated valves (in transmission)
MV-1 and MV-2, reverse-gear lock and
converter clutch, each: 22...60 Ω

Kick-down switch actuated: approx. 0 Ω

Selector switch in position :

	1	2	3	D	N	R	P
Term.18	UB	UB	0	0	0	UB	UB
Term.28	0	0	0	0	UB	0	UB
Term.29	UB	0	UB	0	UB	0	0
Term.30	0	0	0	UB	0	UB	0

UB = Battery voltage (switch on ignition)

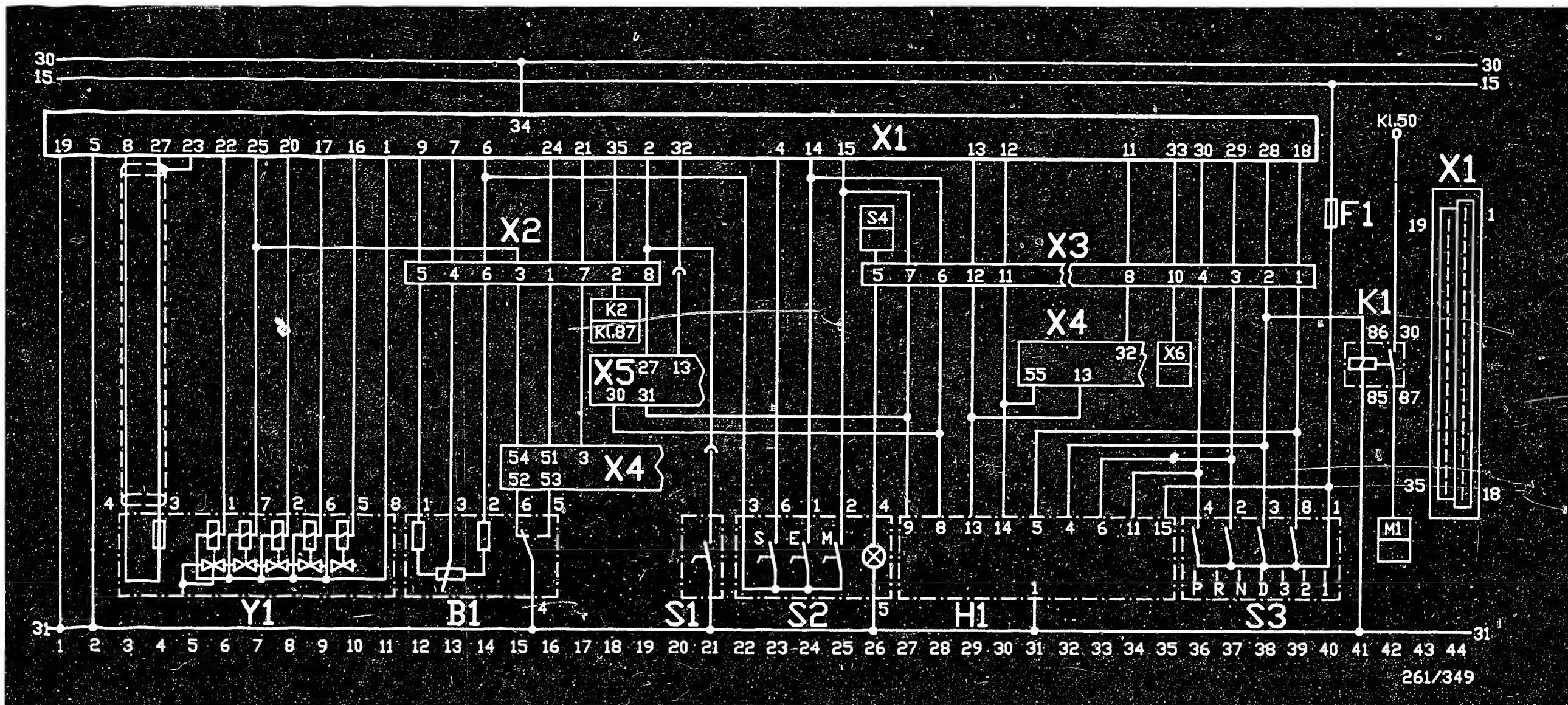
Program switch in position
S (term.4), E (term.14) and M (term.15) actuated
Resistance to ground : approx. 0 Ω in each case

Throttle-valve potentiometer:

Total resistance between pin 1
and pin 2 : 3...5 k Ω

Wiper resistance between pin 3 and
pin 2
(Potentiometer removed and at
idle stop) : 250...800 Ω

For production reasons:
continued on the following
coordinate.

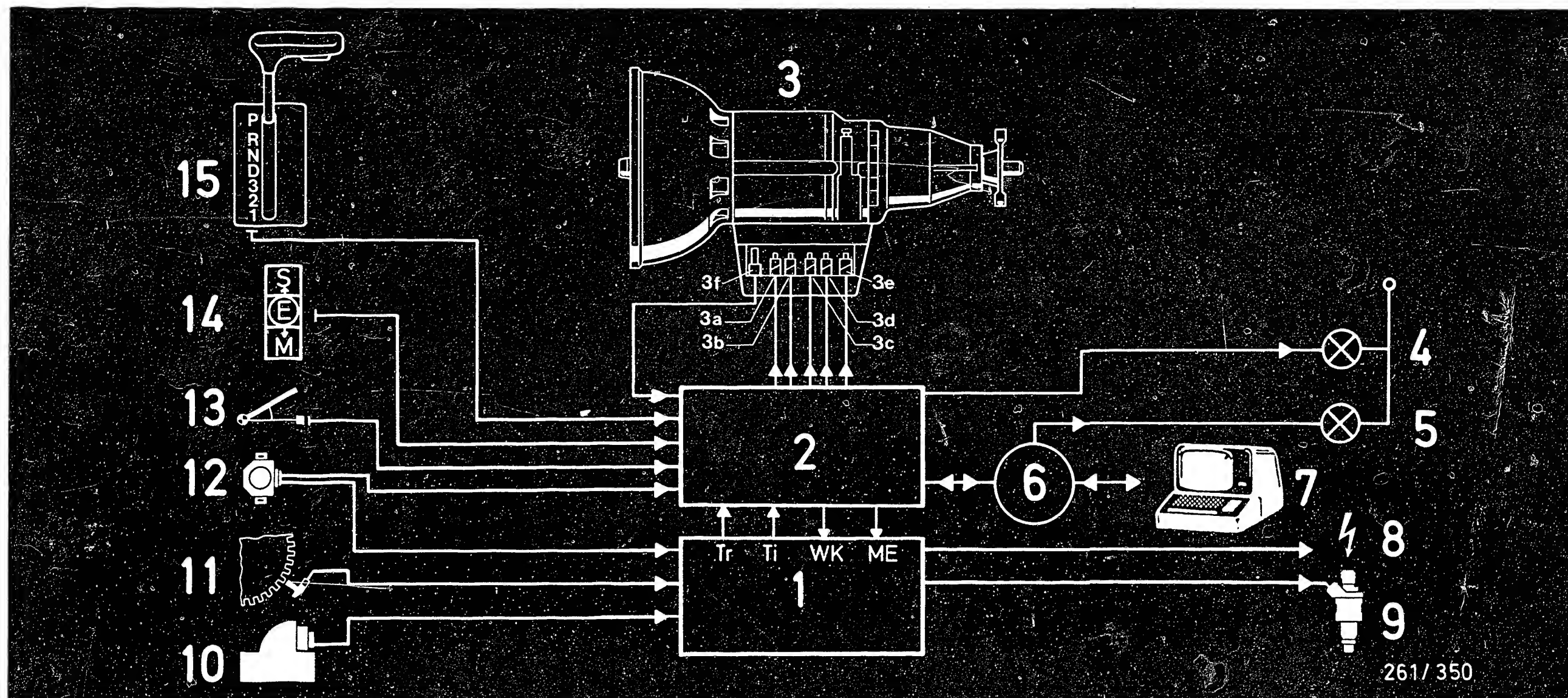


B1 = Throttle-valve sensor
 F1 = Fuse (F17 / 7.5 A)
 H1 = Instrument cluster
 (with display for selector/
 program switches)
 K1 = Starting-interlock relay
 K2 = Main relay
 M1 = Starting motor
 S1 = Kick-down switch

S2 = Program switch
 S3 = Selector switch
 S4 = Light switch
 X1 = GS control-unit plug
 X2 = 8-pin plug-in connection
 to Motronic (electrics box)
 X3 = Plug-in connection to
 instrument wiring harness
 X4 = Motronic control-unit plug

X5 = Electronic-accelerator control-unit
 plug (if electronic accelerator
 fitted, no B1)
 X6 = Check-control-module
 plug
 Y1 = Transmission part with shift
 valves, pressure regulator
 and RPM sensor (8-pin round
 plug on transmission)

ELECTRICAL TERMINAL DIAGRAM (7301, 7351)



- 1 = Motronic control unit
 2 = Electronic-transmission control unit
 3 = Transmission
 3a = Solenoid-operated valves for gear shifting
 3b = Solenoid-operated valve - reverse-gear lock
 3c = Solenoid-operated valve -converter clutch
 3d = Pressure regulator
 3e = RPM sensor

- 4 = Check control
 5 = Fault lamp for flashing-code output
 6 = Diagnosis socket
 7 = Diagnostic tester
 8 = Ignition
 9 = Injection
 10 = Air-flow sensor
 11 = Engine-speed sensor
 12 = Throttle-valve sensor
 13 = Kick-down switch
 14 = Program switch

- 15 = Selector switch

- Tr = Engine-speed information
 Ti = Load information
 WK = Converter-clutch information
 ME = Engine-torque reduction (ignition-timing retard)

BASIC CIRCUIT DIAGRAM

INSTALLATION POSITION OF COMPONENTS (7351)

Control unit for electronic transmission control:
In A-pillar on right

RPM sensor, shift valves, pressure regulator:
In transmission

Connectors for RPM sensor, shift valves, pressure regulator:
On transmission (top picture; arrows)
See center picture for pin assignment

- 1 = RPM sensor
- 2 = Power supply (10...15 V)
- 3 = MV-1
- 4 = MV-2
- 5 = Pressure regulator
- 6 = MV-WK
- 7 = MV-R

Main relay for transmission control and Motronic:
In electrics box (bottom picture; Item 3)

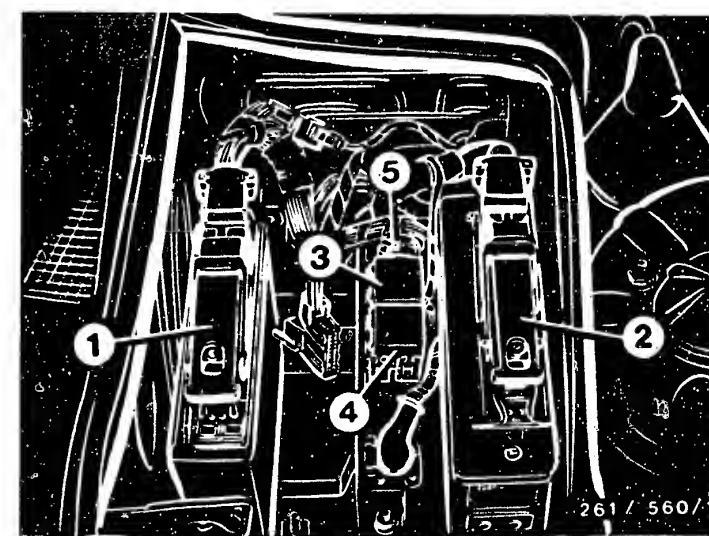
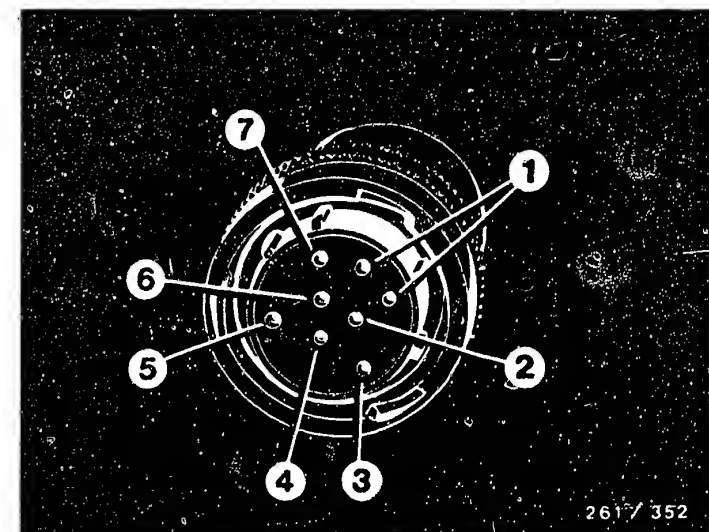
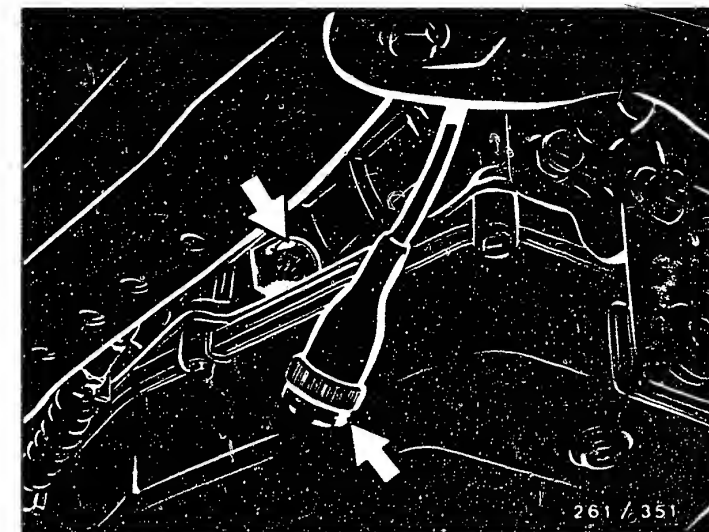
Plug-in connection (8-pin) to Motronic wiring harness:
In electrics box (bottom picture; Item 5)

Kick-down switch:
Under accelerator

Throttle-valve potentiometer:
On throttle-valve assembly

Note :

Adjustment is by means of idle contact, then check voltage at
connector between term. 3 and term. 2. Switch on
ignition; accelerator in rest position : < 1 V
accelerator in full-load position: > 4 V



INSTALLATION POSITION OF COMPONENTS (CONTINUED)

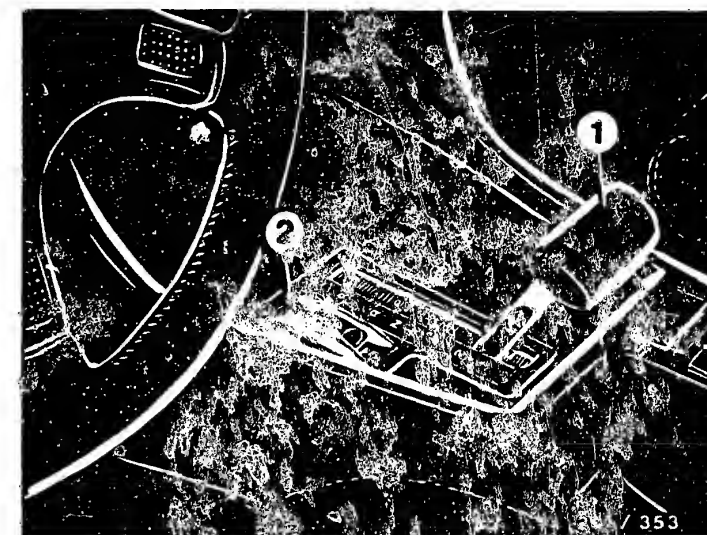
Selector switch:
On control console (top picture)

Program switch:
On control console (top picture)

Display unit for selector switch and program switch:
In instrument panel (bottom picture)

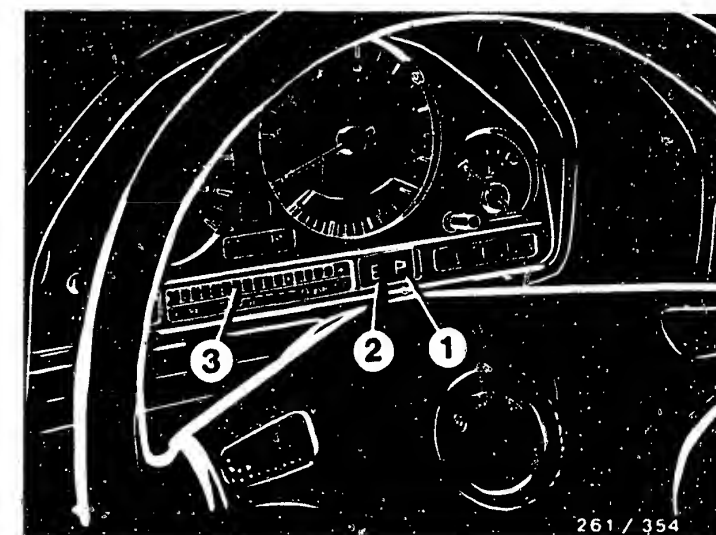
Fault indication for electronic transmission control:
Check control; message "Transmission" (bottom picture)

Diagnosis socket:
Engine compartment, right-hand firewall



1 = Selector switch
2 = Program switch

1 = Display for selector
switch
2 = Display for program
switch
3 = Check control display



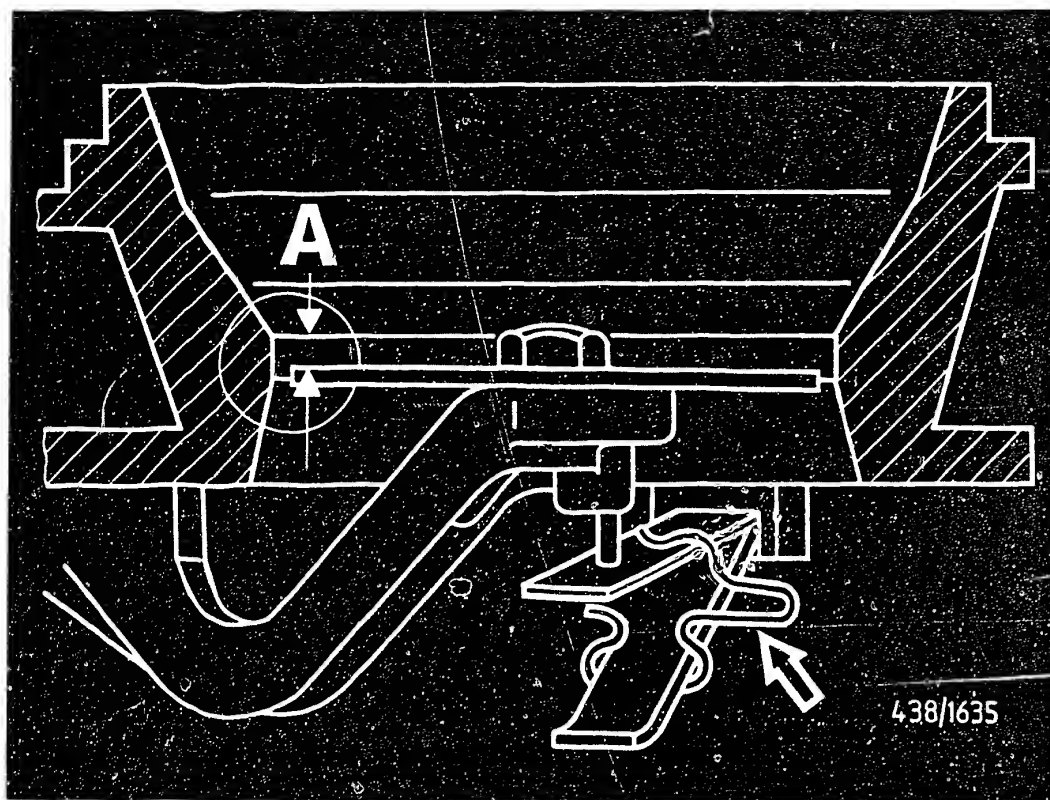
BOSCH system	: K - Jetronic
Make of vehicle	: Audi
Basic microcard	: AUD-01/J2

<u>Section</u>	<u>Coordinate</u>
Special features.....	02
Structure, usage.....	04
Safety and precautionary measures.....	04
Trouble-shooting chart.....	05
Test specifications.....	07
Electrical terminal diagram.....	13
Jumping safety circuit.....	15
Diagram of air/fuel lines.....	17
Installation position of components.....	21

These brief instructions apply to the following vehicle models with 1.970 l / 5-cylinder engine, 81-85 kW valid at the time of writing:

Audi 90 2.0	SK engine	04.86	->
Audi 100 2.0	SL engine	04.86	->
Audi Coupe 2.0	SK engine	04.86	->
VW Passat 2.0	SK engine	05.86	->
VW Passat Syncro 2.0	HP engine	04.86	->

- * K-Jetronic without lambda closed-loop control. Equipped with exhaust-gas recirculation and catalytic converter.
- * Fuel distributor with 5 adjustable differential-pressure valves. Connection for start-valve fuel line at 6th fuel-distributor outlet.
- * Fuel distributor with lower control-plunger seal.
Adjustment of air-flow sensor plate similar to KE-Jetronic.
- * Higher fuel pressure level.
- * Throttle-valve switch and pressure-surge switch for cold-acceleration enrichment by start valve.
- * Injection valves with fixed air-guide cap.
Air shrouding for better mixture formation, particularly at idle.
Air distribution in cylinder head.
- * To connect the injection valves for comparative fuel-delivery measurement, use adapter KDJE-P 200/19.
- * For valve tester use tube fitting KDJE-P 400/7.
- * Electric fuel pump with bolted-on pressure damper for noise reduction.
- * Partly idle-speed stabilization (non-Bosch product) instead of auxiliary-air device, similar to idle-speed control.



Testing and adjustment on mixture-control unit

The lower control-plunger seal corresponds to that of the KE fuel distributor.

- * Zero position of air-flow sensor plate, measured from the cone edge: $A = 1.9 \dots 2.1 \text{ mm}$
Adjustment at shaped spring (arrow).
- * Idle movement between zero position and control plunger, measured at center of air-flow sensor plate: $1 \dots 2 \text{ mm}$. Adjustment at slotted round nut of control-plunger seal. 0.1 mm screw penetration provides approx. 0.7 mm at center of air-flow sensor plate.
- * Basic position of control lever, measured from fuel-distributor support eyes to needle-roller bearing: $21.2 \dots 21.4 \text{ mm}$.
Adjustment at idle-mixture-adjusting screw.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults. For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

I m p o r t a n t :
Never lift the air-flow sensor plate while the electric fuel pump is running because this will inject fuel via the injection valves.
Afterwards, operation of the starter can lead to serious engine damage.

Customer complaint (fault symptoms)

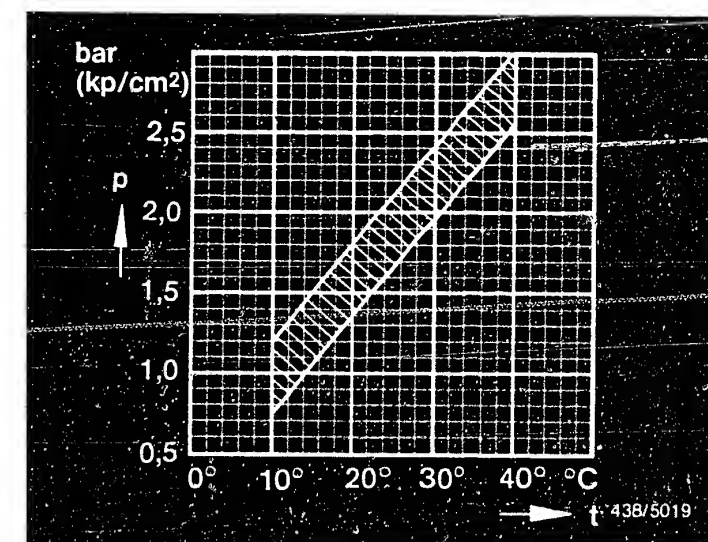
1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

							Cause (component fault)
*	*		*				Electric fuel pump
*		*	*	*			Intake system
*							Fuel system
*		*	*	*	*		Fuel distributor
*		*	*	*	*	*	Air-flow sensor
*		*			*	*	Cold-start system
*		*	*		*		Injection valves
	*		*	*			Primary pressure
*	*	*	*	*	*	*	Control pressure
*		*	*	*			Fuel-delivery dispersion
				*			Throttle valve
*		*					Auxiliary-air device/idle actuator
*		*	*		*	*	Basic idle position
				*			Catalytic converter (if fitted)

For production reasons:
continued on the following
coordinate.

TEST SPECIFICATIONS

No.	Test/Test condition	Set value
1	Electric fuel pump – fuel delivery: Supply voltage (under load):	min. 800 cm ³ /30s min. 11,5 V
2	Control-pressure circuit – fuel delivery	160...240 cm ³ /min
3	Fuel distributor – 0 438 100 151 primary pressure Test specification: Setting:	 5,2...5,9 bar 5,4...5,6 bar
4	Warm-up regulator 0 438 140 113 / 114 –control pressure Control pressure "cold" Simulate manifold pressure with vacuum pump, Setting: 400...600 mbar: Control pressure "warm" At atmospheric pressure: With simulated manifold pressure, Setting: 400...600 mbar: Full-load diaphragm – leakages Simulate manifold pressure with vacuum pump, Setting: 400...600 mbar. Max. permissible pressure drop from setting:	 See diagram 2,7...3,1 bar 4,0...4,4 bar 100 mbar / 15s
5	Overall system – leakages Minimum pressure after 10 min.: Minimum pressure after 20 min.:	 3,4 bar 3,3 bar



p = Control pressure
t = Ambient temperature

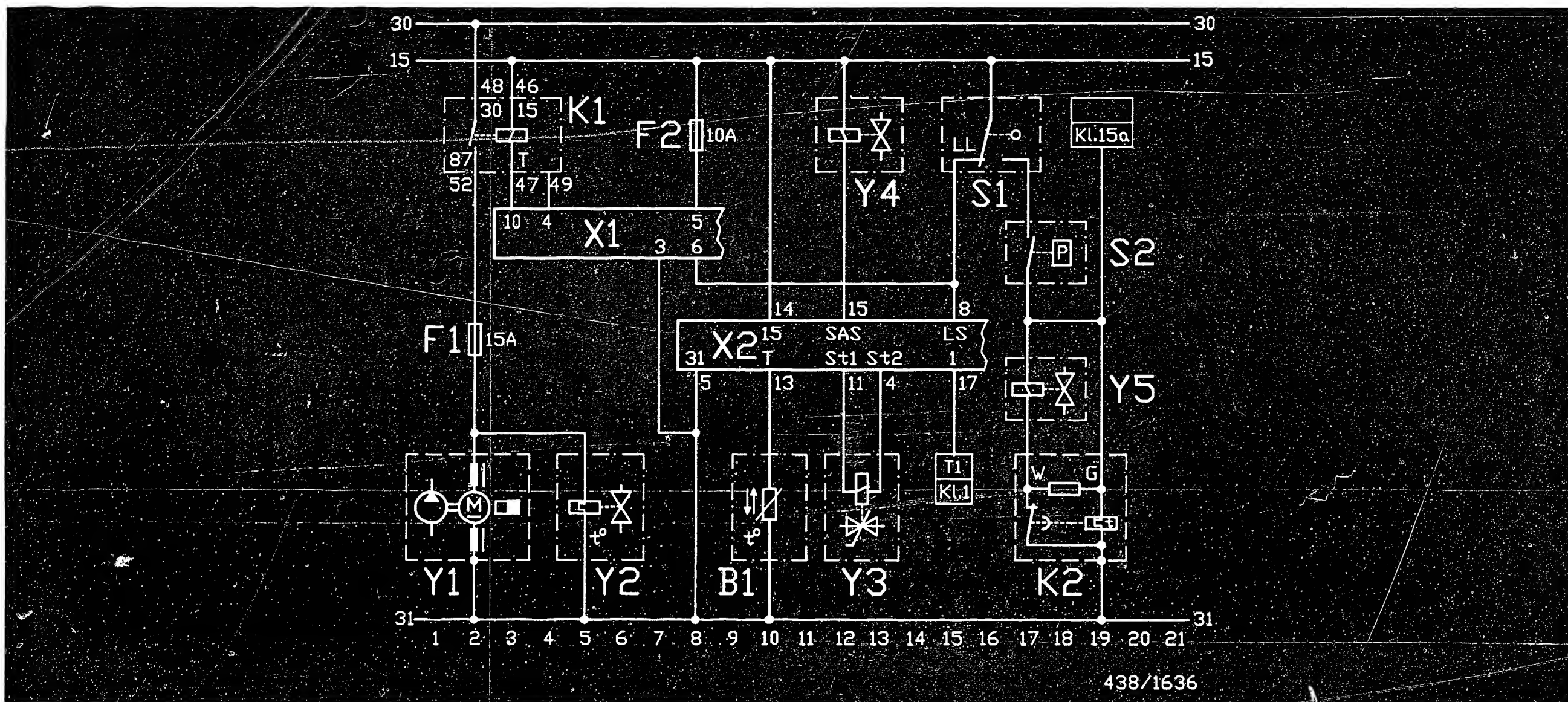
TEST SPECIFICATIONS (CONTINUED)

No.	Test/Test condition	Set values	
6	Injection valve 0 437 502 032 / 033 Opening pressure: Leakage test not less than 3,5 bar:	3,7...4,8 bar There must be no dripping within 25s.	
7	Fuel distributor 0 438 100 151 Comparative fuel-delivery measurement	Setting point: (cm ³ /min)	max. perm. quantity: (cm ³ /min)
	Idle:	6,0	6,6
	Part load:	40,0	43,0
	Full load:	122,0	134,0
	Minimum quantity at max. deflection of air-flow sensor plate:	122 cm ³ /min	
8.1	Thermo-time switch 0 280 130 214 / 223 Resistance measurement	below + 30°C	above + 40°C
	Terminal G and ground:	25...40 Ω	50... 80 Ω
	Terminal W and ground:	0 Ω	100...160 Ω
	Terminal G and terminal W:	25...40 Ω	50... 80 Ω
8.2	Thermo-time switch 0 280 130 219 / 228 Resistance measurement	below +10°C	above +20°C
	Terminal G and ground:	50...70 Ω	50...70 Ω
	Terminal W and ground:	0 Ω	infinity Ω
	Terminal G and terminal W:	50...70 Ω	infinity Ω

TEST SPECIFICATIONS (CONTINUED)

No.	Test/Test condition	Set value
9	Idle adjustment: Idle speed Manual gearbox: Automatic gearbox: Air conditioner switched on: Idle-actuator current Air conditioner switched off: Air conditioner switched on: CO content:	 750...850 min ⁻¹ 670...770 min ⁻¹ approx.100 min ⁻¹ higher 420...440 mA 480...500 mA 0,5...1,5 % by vol.

- * Notes on idle-speed adjustment:
 Engine-oil temperature at least 80 °C.
 Detach hose for crankcase ventilation and position such that only fresh air can be drawn in.
 Render overrun cut-off and exhaust-gas recirculation inoperative (if fitted).
 Switch off all electrical loads.
 Fan for radiator must not be running.



438/1636

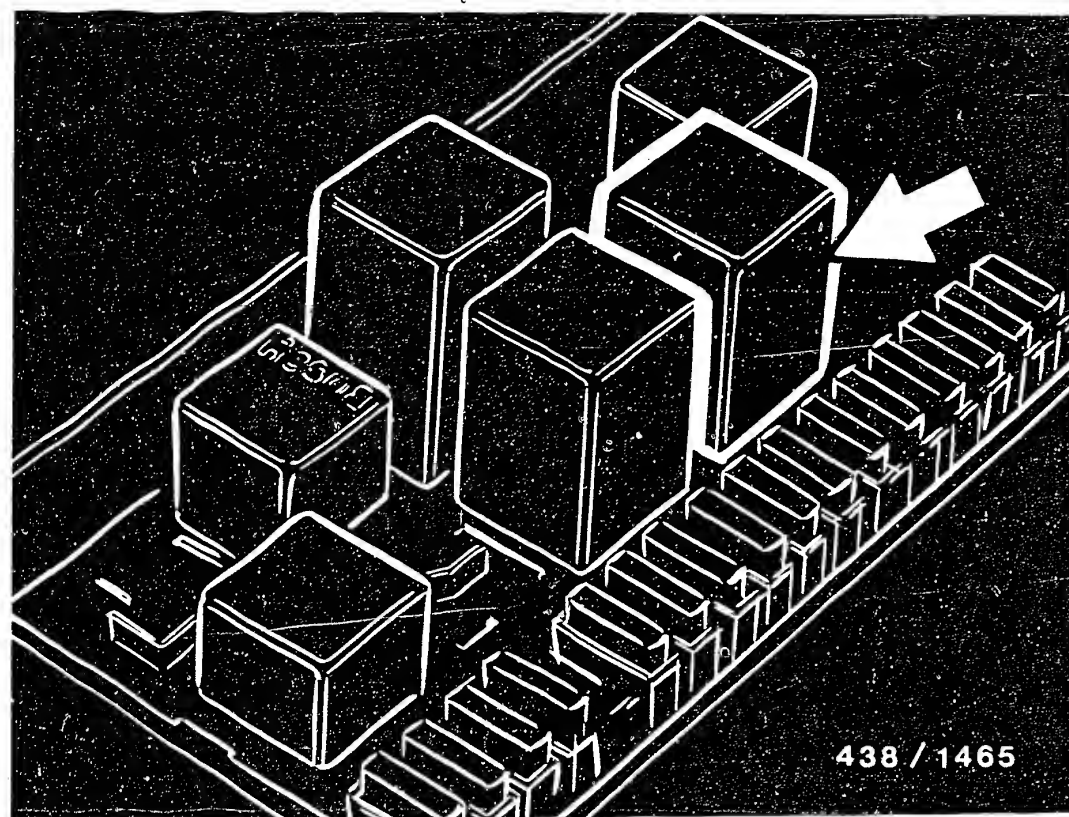
B1 = Temperature sensor (engine)
 F1 = Pump fuse
 F2 = Fuse for ignition control unit
 K1 = Fuel-pump relay
 K2 = Thermo-time switch
 S1 = Throttle-valve switch

S2 = Pressure-surge switch
 X1 = Ignition-control-unit plug
 X2 = Control-unit plug for idle
 stabilization and overrun
 cut-off
 Y1 = Electric fuel pump

Y2 = Warm-up regulator
 Y3 = Idle actuator
 Y4 = Overrun-cutoff valve
 Y5 = Start valve

ELECTRICAL TERMINAL DIAGRAM

The safety circuit with fuel-pump relay is activated from terminal 10 of the control unit of the electronic ignition system (ground supply).
 Cold acceleration enrichment by means of start valve. Temperature-dependent by thermo-time switch, triggered by pressure-surge and throttle-valve switches.

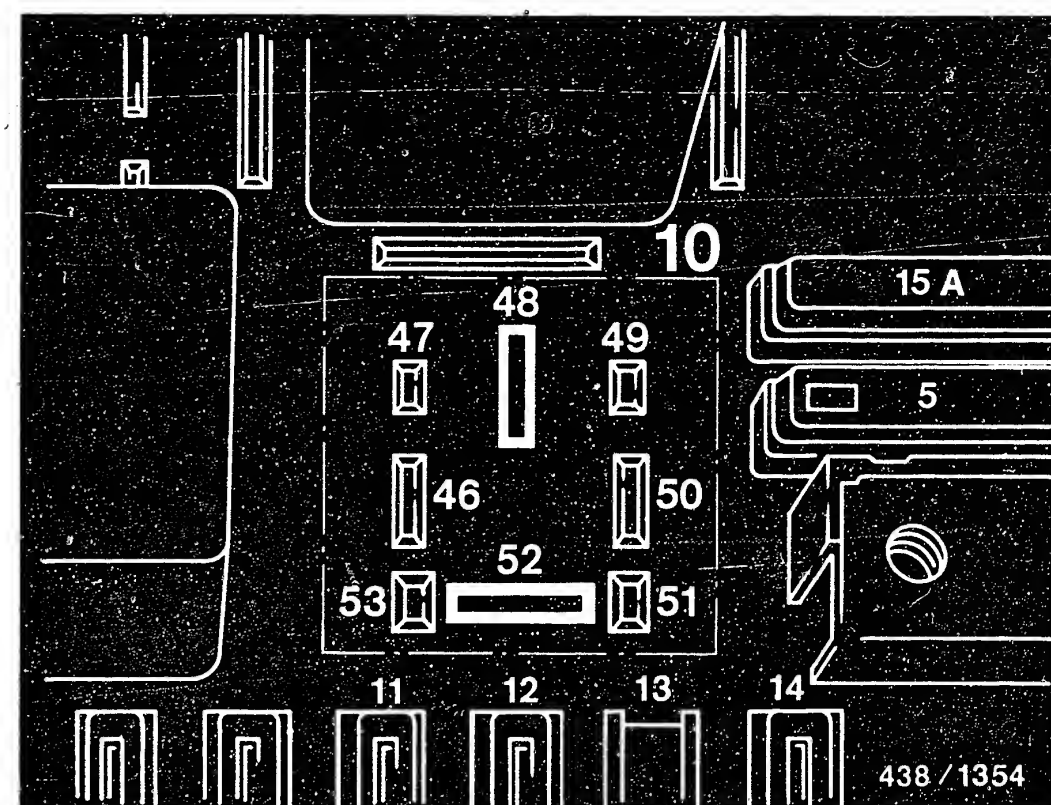


Arrow = Fuel-pump relay

JUMPER SAFETY CIRCUIT

In order to carry out test work with the engine at a standstill, jumper safety circuit.

Pull fuel-pump relay (relay position 10 in central electrical system) out of relay plate.



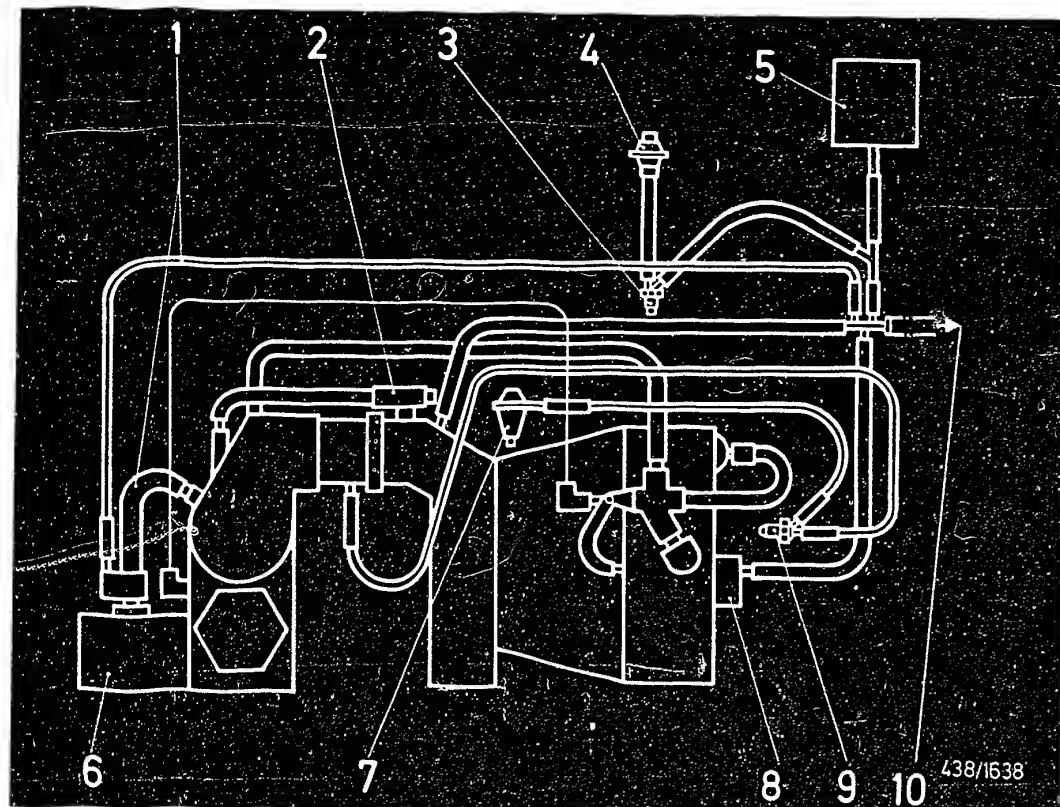
Connect contact 52/87 to 48/30 in the pin base with a bridge. Use 1.5 mm² connecting cable with fusible element and 16 amp fuse. Width of blade terminal: 9.5 mm.

Battery voltage is supplied to electric fuel pump and warm-up regulator.

C a u t i o n :

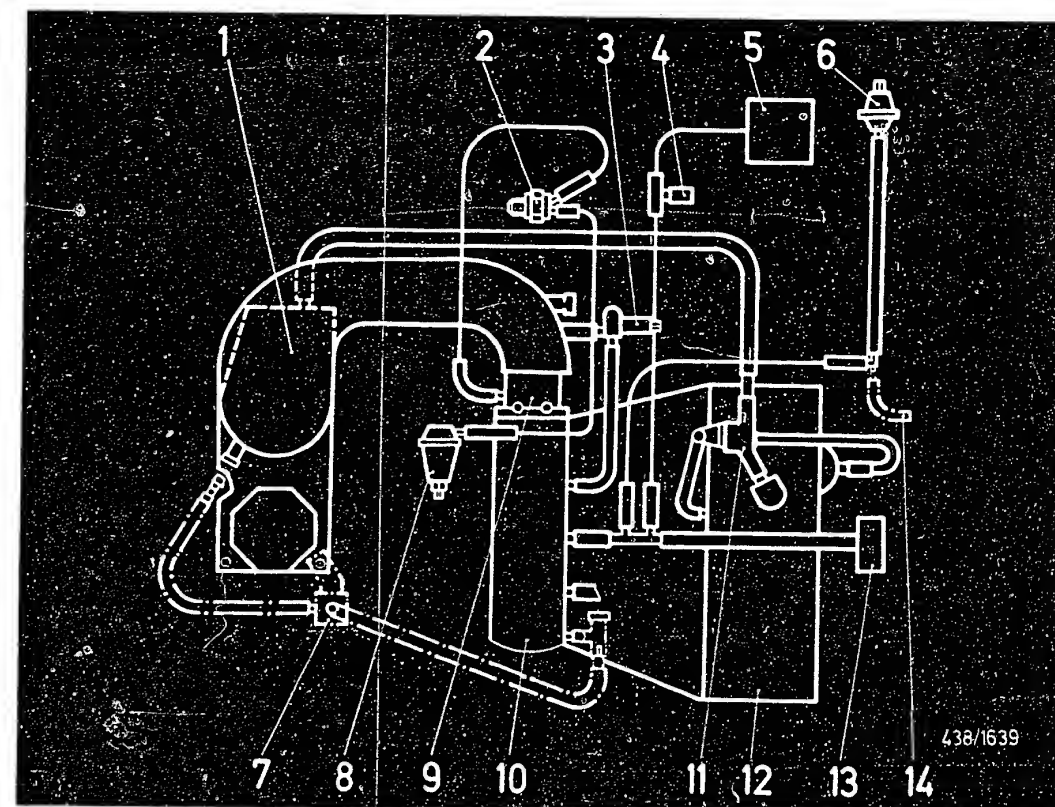
Never deflect (raise) the air-flow sensor plate when the electric fuel pump is running, since fuel is then injected via the injection valves.

Subsequent actuation of the starting motor can lead to major damage to the engine.



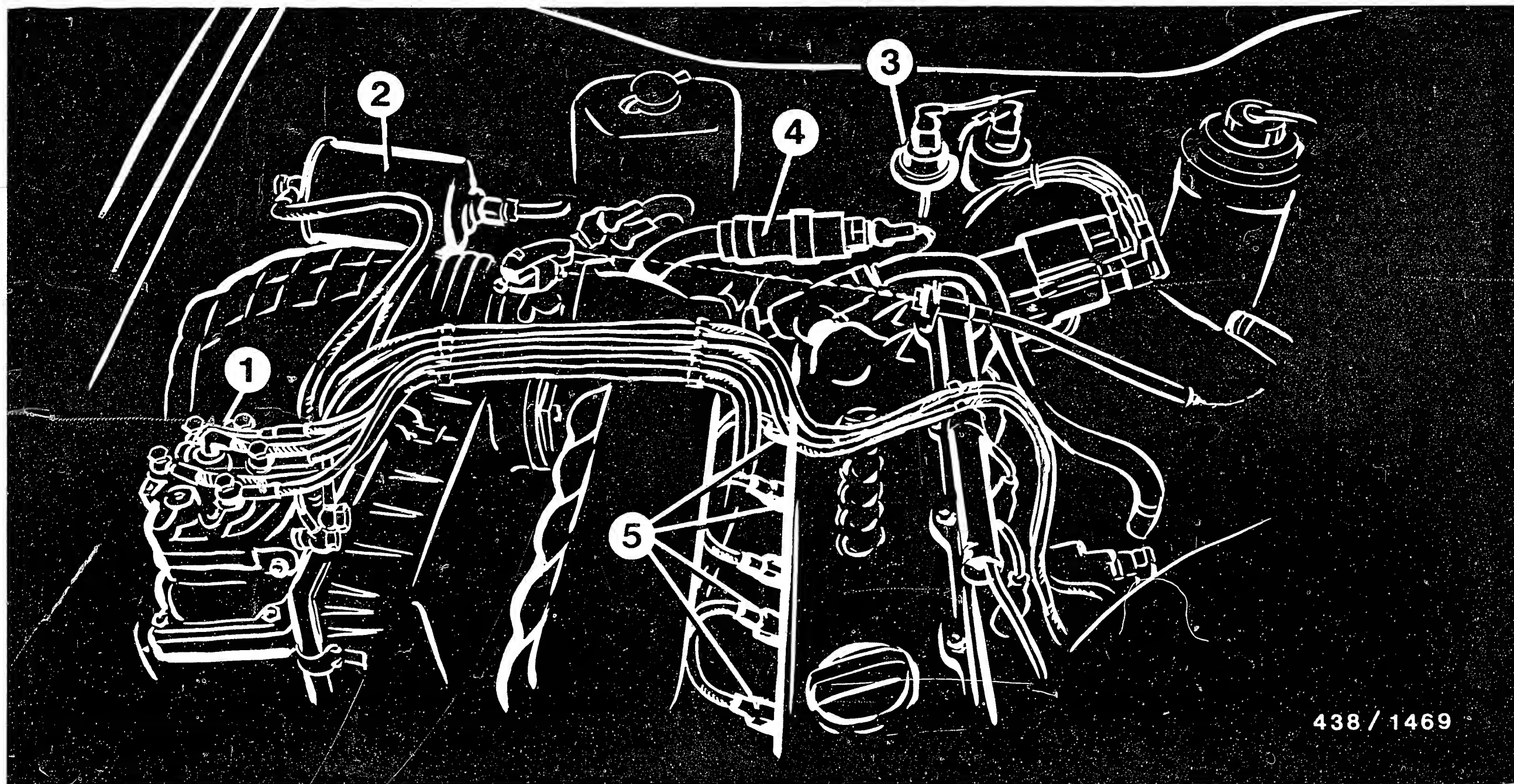
- 1 = With manual transmission only
- 2 = Idle actuator for stabilization
- 3 = Thermopneumatic valve 18 ... 28 °C for pressure-surge switch.
- 4 = Pressure-surge switch
- 5 = Ignition control unit
- 6 = Overrun-cutoff valve with manual transmission
- 7 = Exhaust-gas-recirculation valve
- 8 = Warm-up regulator
- 9 = Thermopneumatic valve 48 ... 58 °C for exhaust-gas-recirculation valve.
- 10 = to air conditioner

Diagram of hoses, SL engine



- 1 = Mixture-control unit
- 2 = Thermopneumatic valve
- 3 = Auxiliary-air device
- 4 = to differential lock
- 5 = Ignition control unit
- 6 = Pressure-surge switch
- 7 = Solenoid-op. changeover valve with air conditioner
- 8 = Exhaust-gas-recirculation valve
- 9 = Throttle-valve section
- 10 = Intake manifold
- 11 = Crankcase ventilation
- 12 = Cylinder head
- 13 = Warm-up regulator
- 14 = to air conditioner

Diagram of hoses, SK engine



438 / 1469

1 = Mixture-control unit
2 = Fuel accumulator

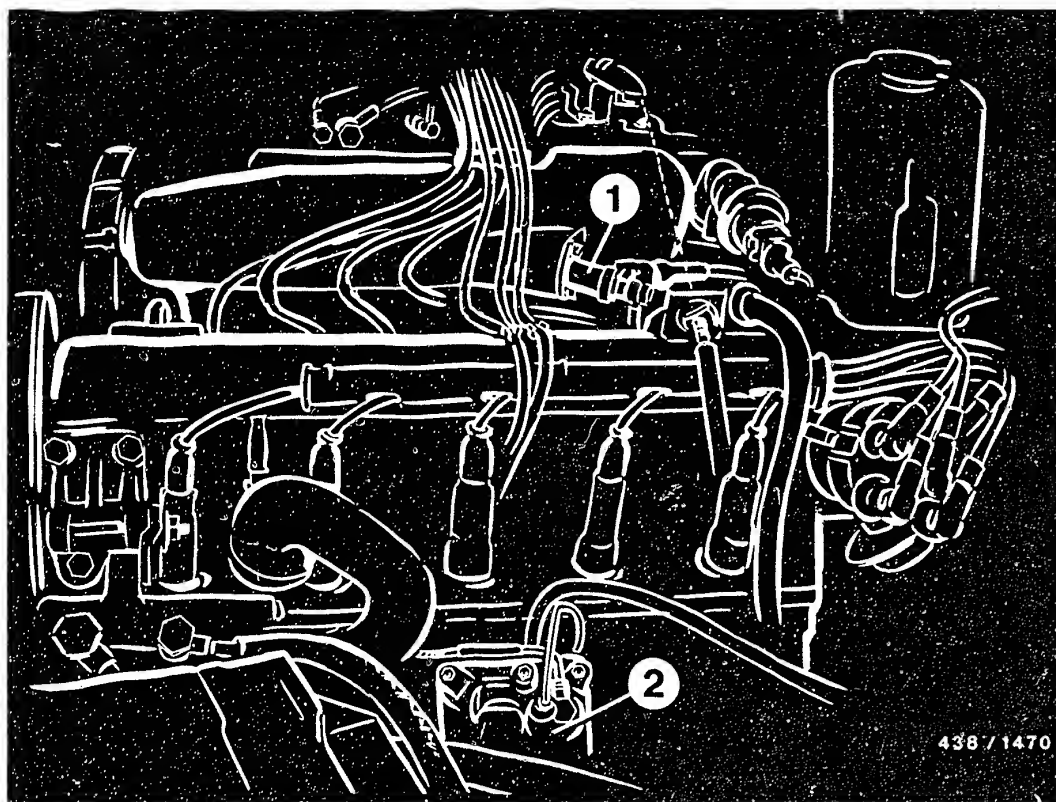
3 = Pressure-surge switch
4 = Idle actuator

5 = Injection valves

INSTALLATION POSITION OF COMPONENTS

Arrangement of the components on the engine

Illustration shows predecessor engine, JS and KP, fuel distributor with old inlet-union screw type of connection.



1 = Start valve
2 = Warm-up regulator

Further components

- * Thermo-time switch in coolant-distributor head.
- * Fuel-pump relay in central electrical system, relay position 10.
- * Control unit for idle stabilization and overrun cutoff in additional relay carrier, 2 or 3 relay positions 10, 11 and 12.
- * The in-tank electric fuel pump with bolted-on pressure damper is accessible via the closing ring on the top of the fuel tank.

For production reasons:
continued on the following
coordinate.

Trouble-shooting instructions : AUD-5004
BOSCH system : KE-Jetronic .
Make of vehicle : AUDI
Basic microcard : PKW-065

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SPECIAL FEATURES

* These instructions contain KE-Jetronic trouble-shooting for the following Audi models valid at the time of writing:

AUDI 100, 100 Quattro
Engine NF / 2.3 l / 5 cylinder 06.86->

Audi 90, 90 Quattro
Engine NG / 2.3 l / 5 cylinder 04.87->

- * KE-Jetronic system version 3.2 with self-diagnosis and flashing-code output
- * Final-controlling-element diagnosis
- * Tank ventilation with timed valve
- * Lambda closed-loop control
- * In-tank electric fuel pump in AUDI 100 model
- * Electronic ignition with knock control, self-diagnosis and flashing-code output

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.

For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to prevent damage to the engine, trigger boxes and control units or to the ignition system, be sure to observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

For testing the compression, disconnect the pump relay in order to prevent undesired injection by the injection valves.

Important information with regard to working on the KE Jetronic.

If any fuel connections are loosened or parts removed, also on the vacuum system, always use new seals when re-connecting or re-mounting.

Be sure to keep everything clean when working on the KE-Jetronic. Clean the external areas of fuel connections thoroughly before loosening them.

While conducting tests with the electric fuel pump running, never deflect (lift) the air-flow sensor plate, since this leads to fuel being injected via the injection valve. This may lead to very serious damage to the engine, when the engine is started afterwards.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts, but dies again.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)

*	*	*	*	*	*	*	*			*	Self-diagnosis
*	*	*	*	*	*	*		*	*		Pressure actuator
		*									Tank-vent valve
		*									Idle actuator
*		*				*					Cold-start valve
*		*	*		*						Intake system
*	*	*	*					*			Air-flow sensor
*								*			Air-flow sensor plate
*	*			*	*						Electric fuel pump
*	*			*	*						Primary pressure
*	*	*	*	*	*	*					Differential pressure
*											Fuel system leaking
*	*	*	*	*	*		*				Injection valves
*	*	*	*		*	*					Fuel distributor

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts, but dies again.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)

*	*	*	*	*					Throttle valve
*	*	*	*	*			*	*	Voltage supply, control unit
*	*	*	*	*	*				Temperature sensor (coolant)
		*	*						Throttle-valve switch, idle
				*			*	*	Throttle-valve switch, full load
		*	*	*					Lambda closed-loop control
*	*	*	*		*				Exhaust-gas adjustment
		*							Low-idle-speed control
*									Starting enrichment
	*								Post-starting enrichment
	*	*	*						Warm-up enrichment
			*						Acceleration enrichment
			*	*					Full-load enrichment
				*					Overrun cut-off

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Checking of component/function	Test instructions/ Test conditions	Term- inals	Set values
1 1 1 1	Control units	Watch whether fault-code output concerns EI-K or KE! EI-K control unit or KE control unit faulty.		
2 1 2 1	Throttle-valve switch, idle or cable faulty	Watch whether fault-code output concerns EI-K or KE! Throttle-valve switch, idle, permanently closed. Cable to terminal 28 has short circuit to positive. Setting incorrect. Throttle valve closed: Throttle valve open: Check setting:	KE 28 EI-K 7	0 Ω infinity Ω 0.6 mm
2 1 2 2	No engine-speed signal from ignition system	Lead from KE control unit terminal 30 to EI-K control unit terminal 17 interrupted. Check lead for continuity: Check ignition system: see SIS overview (KFZ 00.)	KE 30 EI-K 17	0 Ω
2 1 2 3	Throttle-valve switch, full load or cable faulty	Watch whether fault-code output concerns EI-K or KE! Throttle-valve switch, full load, permanently closed. Cable to terminal 28 has short circuit to positive. Setting incorrect. Throttle valve closed: Throttle valve open: Check setting:	KE 31 EI-K 9	infinity Ω 0 Ω 68...76°
2 1 4 1	Knock control at control stop	Check ignition system: see SIS overview (KFZ 00.)		
2 1 4 2	Knock sensor or cable faulty	Check ignition system: see SIS overview (KFZ 00.)		

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Checking of component/function	Test instructions/ Test conditions	Term- inals	Set values
2 2 2 3	Altitude sensor or cable faulty	Watch whether fault-code output concerns EI-K or KE! Check voltage supply to altitude sensor at terminals 2 and 3. Check voltage signal at terminals 1 and 3. Open circuit. Check cable for continuity:	KE 25, 26,35 EI-K 2	4.35...5.35 V see test specifications 0 Ω
2 2 3 2	Potentiometer at air-flow sensor or cable faulty	Check voltage supply to potentiometer at terminals 1 and 3. Check voltage signal at terminals 1 and 2. Open circuit. Check cable for continuity:	KE 23, 26,35	4.35...5.35 V Voltage rise, max. 5.35 V 0 Ω
2 2 3 3	Reference voltage for load and altitude signal for EI-K control unit	Cable from KE control unit terminal 26 to EI-K control unit terminal 21 interrupted. Check cable for continuity:	KE 26 EI-K 21	0 Ω
2 3 1 2	Temperature sensor (engine) or cable faulty (double NTC, one connection for KE-Jetronic)	Watch whether fault-code output concerns EI-K or KE! Cable from KE control unit terminal 3 to temperature sensor (engine) interrupted or short circuit to ground. Check cable for continuity: Check cables for short circuit to ground: Resistance value, temperature sensor (engine) * Engine cold (+15°C...+30°C) * Engine at operating temperature (approx. +80°C)	KE 3	0 Ω infinity Ω 1300...3600 Ω 250... 390 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Checking of component/function	Test instructions/ Test conditions	Terminals	Set values
2 3 4 1	Lambda closed-loop control outside working range (above or below control limits)	<p>Fault occurs only at idle/in part-load range. Fault detected 6 minutes after starting at the earliest. Possible causes of fault:</p> <ul style="list-style-type: none"> * Lambda closed-loop control not working or functioning incorrectly, sensor lead short-circuited, lambda-sensor heating faulty. * Start valve leaking. * Intake system leaking (unmetered air). * Tank-vent. valve permanently open. * Incorrect idle setting. 	— —	— —
2 3 4 2	Lambda sensor or cable faulty	<p>Cable from KE control unit terminal 7 to lambda sensor broken, short-circuited to ground or battery voltage Check cable for continuity: Check cables for short circuit to ground and battery voltage: Pay attention to chafing points! Sensor heating faulty. Resistance value, sensor clogged:</p>	KE 7	<p>0 Ω infinity Ω 1...15 Ω</p>
4 3 4 1	Pressure actuator or cable faulty	<p>Check resistance of pressure actuator: Check cable for continuity:</p>	KE 4,5	<p>16...22 Ω 0 Ω</p>
4 3 4 3	Tank-ventilation valve or cable faulty	<p>Cable from KE control unit terminal 15 to tank-ventilation valve broken or short circuit to ground. Check voltage supply (ignition terminal 15) to tank-ventilation valve: Check cable for continuity: Check cables for short circuit to ground:</p>	KE 15	<p>Battery voltage 0 Ω infinity Ω</p>

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

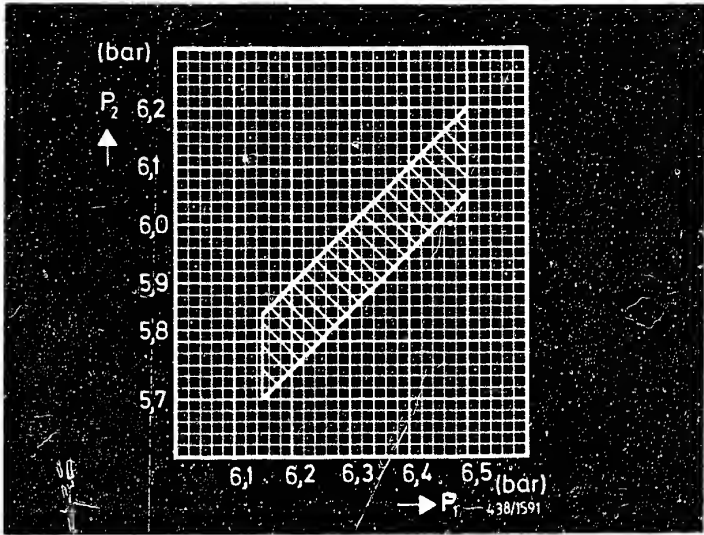
Fault indication Flashing code	Checking of component/function	Test instructions/ Test conditions	Term- inals	Set values
4 4 3 1	Idle actuator or cable faulty	Cable from KE control unit terminal 17 to idle actuator broken or short circuit to ground. Voltage supply (ignition terminal 15) to idle actuator interrupted. Check cable for continuity: Check cables for short-circuit to ground:	KE 17	Battery voltage 0 Ω infinity Ω
4 4 4 3	Start valve or cable faulty	Cable from KE control unit terminal 16 to cold- start valve broken or short circuit to ground. Voltage supply (ignition terminal 15) to start valve broken. Check cables for continuity: Check cables for short circuit to ground:	KE 16	Battery voltage 0 Ω infinity Ω
4 4 4 4	No fault			
0 0 0 0	End of fault output			

TEST SPECIFICATIONS

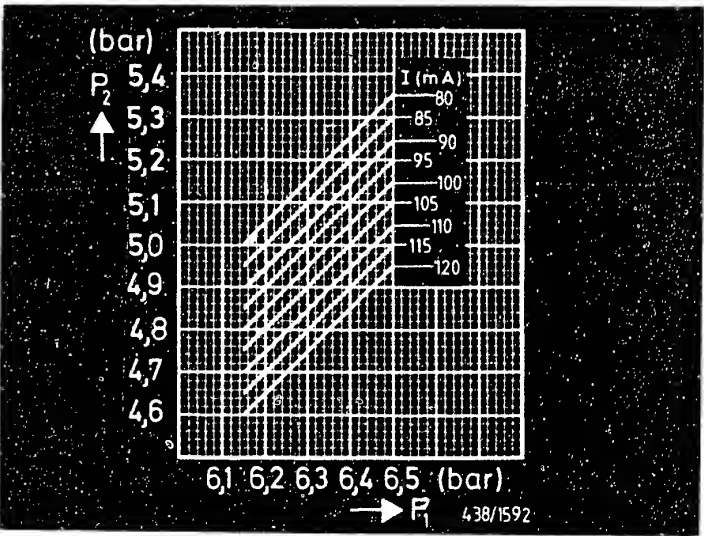
No.	Testing/Test conditions	Set value
1	Engine-speed signal from EI-K control unit to KE control unit:	approx. 5,0 V
2	Supply voltage for altitude sensor: Voltage signal from altitude sensor: <div>Sea level 500 m 1000 m 1500 m 2000 m 3000 m</div>	4,35...5,35 V 3,2...4,7 V 2,8...4,0 V 2,4...3,5 V 2,0...3,0 V 1,5...2,5 V 0,8...1,6 V
3	Supply voltage for potentiometer on air-flow sensor: Voltage signal from potentiometer: air-flow sensor plate in neutral position air-flow sensor plate deflected	4,35...5,35 V 5,35 V max. 21 V
4	Resistance value, temperature sensor (coolant): engine cold (+15°C...+30°C) Engine at normal operating temperature (approx. 80°C)	1300...3600 Ω 250... 390 Ω
5	Lambda closed-loop control: open-loop control operation closed-loop control operation rich stop lean stop	-1...+1 mA (static) -1...+1 mA (pulsating) max. +10 mA max. -10 mA
6	Resistance value, pressure actuator:	16...22 Ω
7	Resistance value, tank-vent valve:	35...55 Ω
8	Resistance value, idle actuator:	4...12 Ω
9	Resistance value, cold-start valve:	6...14 Ω

TEST SPECIFICATIONS (CONTINUED)

No.	Test/test condition	Set value	
10	Position of air-flow sensor plate (zero position) beneath basic position:	1,9...3,0 mm	
11	Air-flow sensor plate idle motion:	0,1...2,0 mm	
12	Electric fuel pump - fuel delivery: Supply voltage (under load):	min. 1160 cm ³ /min min. 11,5 V	
13	Fuel distributor - primary pressure:	6,15...6,5 bar	
14	Differential pressure Take lower-chamber pressure "warm" set value in accordance with measured primary pressure from upper diagram (actuator current = 0 mA) Take lower-chamber pressure "cold" set value in accordance with measured primary pressure and actuator current from lower diagram. Simulation of "cold" state: switch on ignition (closed-circuit current approx. 100 mA)		
15	Leakage test for entire system: Minimum pressure after 10 min.: Minimum pressure after 20 min.:	3,3 bar 3,2 bar	
16	Opening pressure of injection valves:	3,7...4,8 bar	
17	Comparative fuel-delivery measurement: Actuator current: 0A Idle: Part load: Full load: Minimum quantity at max. deflection of air-flow sensor plate:	Setting: (cm ³ /min) 6,0 40,0 100,0 125,0 cm ³ /min	Max. perm. quantity: (cm ³ /min) 6,6 42,5 109,0



P 1 = Primary pressure ure
P 2 = Lower-chamber pressure .
I = Actuator r current



TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test conditions	Set value
18	Rate of flow, KE restriction	cm ³ /min
19	Control-unit functions: Starting enrichment Post-start enrichment Warm-up enrichment Acceleration enrichment * Slowly increase engine speed Full-load enrichment Overrun cut-off	130...150 mA 90...110 mA 20... 30 mA Current value increases 10... 15 mA 4... 8 mA
20	CO-content adjustment* Idle speed: CO content: * Lambda sensor disconnected Check value Setting * Lambda-sensor connected Pressure-actuator current	-40...-60 min ⁻¹ 670...770 % by vol. 0,3...3,0 % by vol. 0,6...1,0 % by vol. 0,3...2,2 mA

* Notes on CO-content adjustment:

Adjustment of the idle speed is not possible.

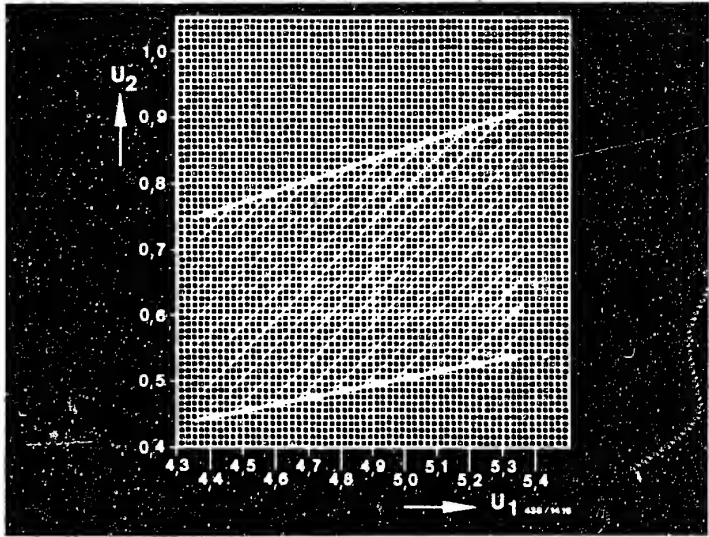
Engine-oil temperature at least 80 °C.

Hose for crankcase ventilation is disconnected and sealed off tightly.

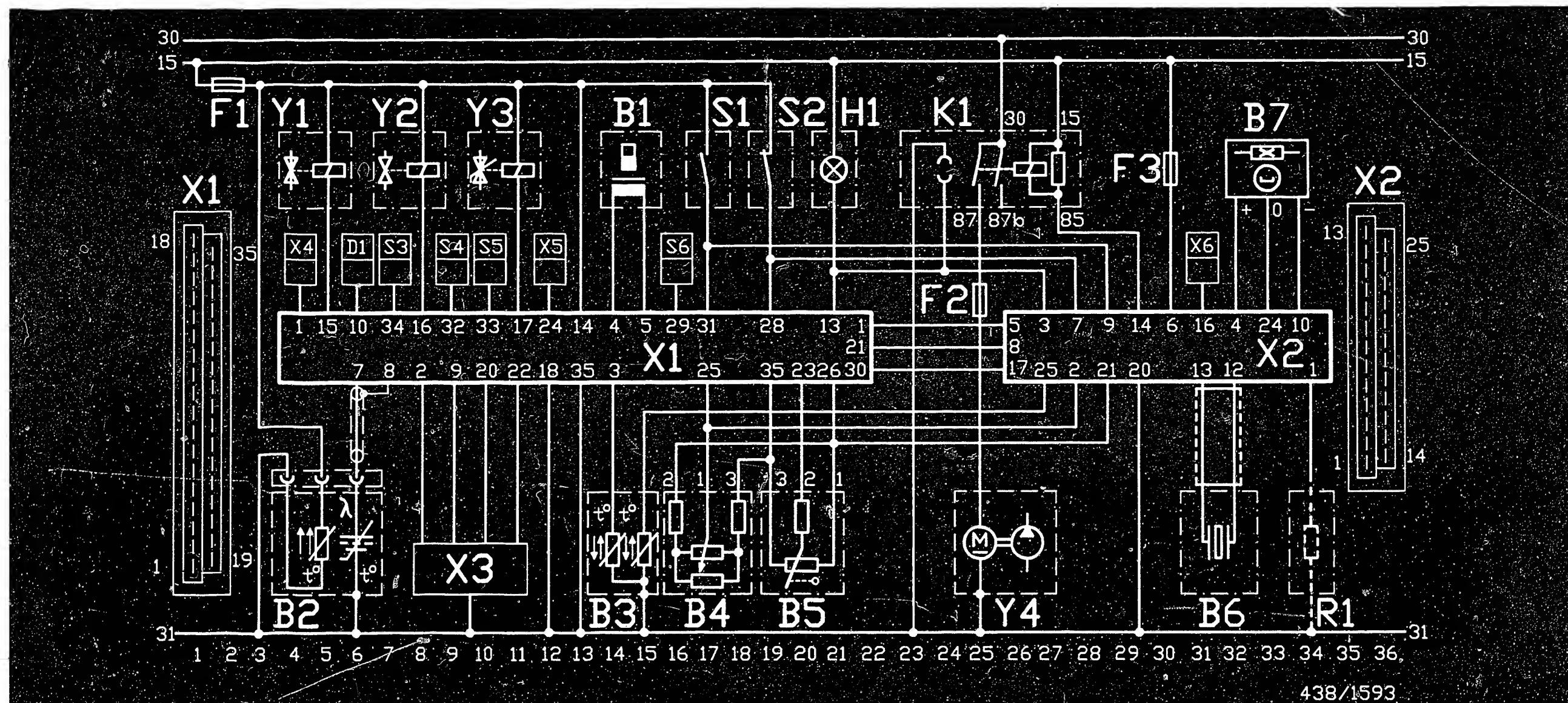
Disconnect the hose line to the activated-carbon filter on the air scoop (bracket remains open in the scoop).

TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test conditions	Set value
21	<p>Signal, air-flow sensor potentiometer (measurement necessary only when idling and part-load behavior are poor).</p> <p>* Measure supply voltage at potentiometer terminals 1(+) and 3(-) and not down:</p> <p>* Measure voltage signal of potentiometer terminals 2(+) and 3(-) with engine at normal operating temperature and at idle speed and compare with set value from chart opposite.</p>	<p>4,35...5,35 V</p> <p>see chart</p>



U 1 = Supply voltage,
potentiometer
U 2 = Potentiometer
voltage signal



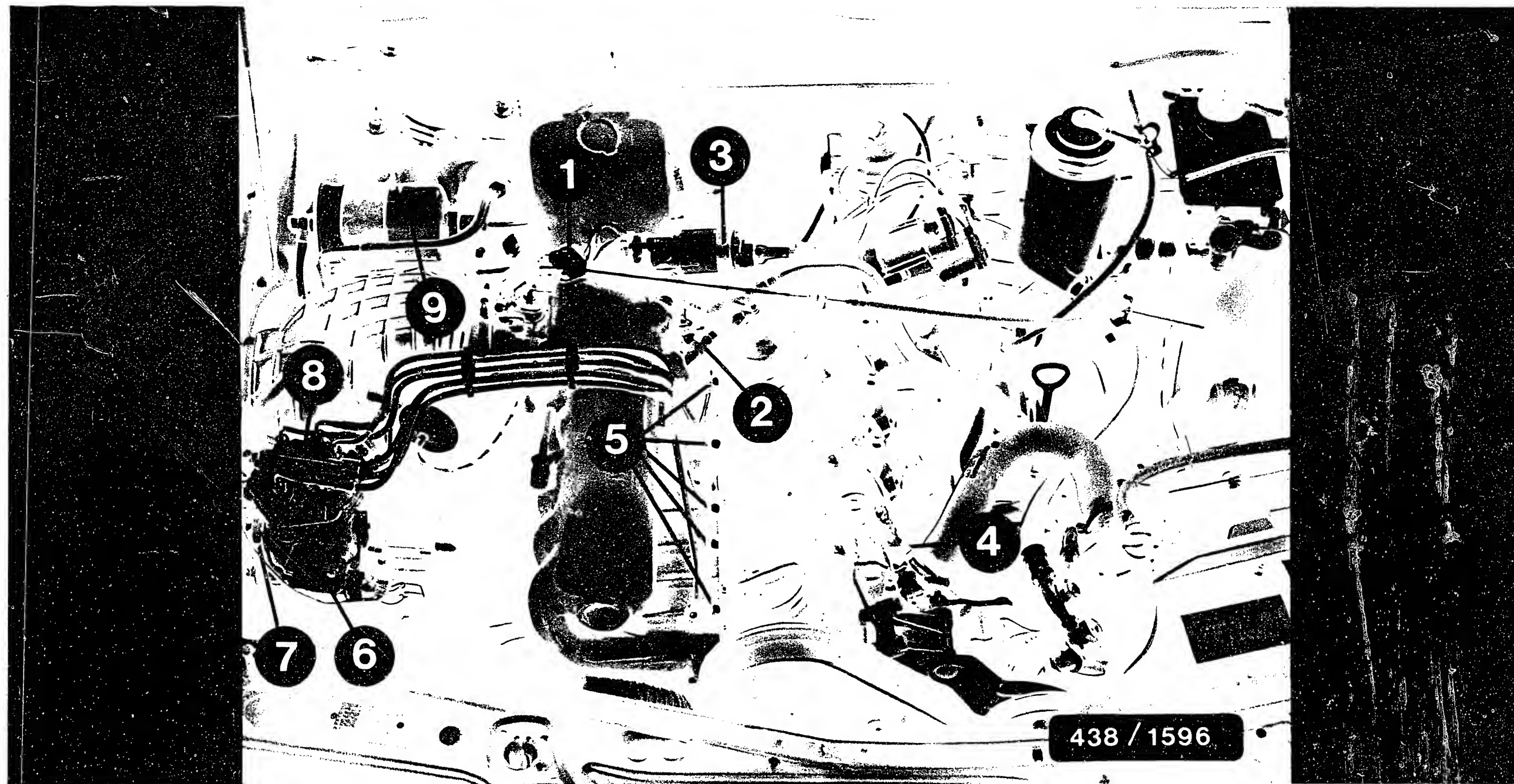
438/1593

B1 = Pressure actuator
 B2 = Lambda sensor
 B3 = Temperature sensor (coolant)
 B4 = Altitude sensor
 B5 = Air-flow sensor potentiometer
 B6 = Knock sensor
 E1 = Ignition distributor
 F1 = 10 A fuse
 F2 = 8 A fuse
 H1 = Diagnostic lamp

K1 = Electric-fuel-pump relay
 R1 = Resistance, variant encoding
 S1 = Full-load throttle-valve switch
 S2 = Idle throttle-valve switch
 T1 = Ignition coil
 U1 = Connection, diagnosis interface
 U2 = Connection, on-board computer
 U3 = Connection, transmission switch
 (in vehicles with man. shifted trans. to ground)
 U4 = Connection, air-conditioner readiness for op.

U5 = Connection, air-cond. compress.
 U6 = Connection, idle encoding
 U7 = Connec., overrun cut-off supp.
 X1 = Plug, KE control unit
 X2 = Plug, EI-K control unit
 X3 = Plug, parameter encoding
 Y1 = Tank-vent valve
 Y2 = Cold-start valve
 Y3 = Idle actuator
 Y4 = Electric fuel pump

ELECTRICAL TERMINAL DIAGRAM



- 1 = Throttle-valve switch (full load).
The throttle-valve switch, idle (not visible in picture) is located on the underside of the throttle-valve assembly.
- 2 = Start valve
- 3 = Idle actuator

- 4 = Temperature sensor (engine)
- 5 = Injection valves
- 6 = Pressure actuator
- 7 = Potentiometer at air-flow sensor
- 8 = Fuel distributor
- 9 = Fuel filter

INSTALLATION POSITION OF COMPONENTS (in picture: AUDI 100)

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

AUDI 100:

- * EI-K control unit:
In driver's footwell.
- * Altitude sensor:
Above the EI-K control unit.
The components are accessible when the shelf, the unlocking mechanism for the engine-compartment hood and the side covering are removed.
- * KE control unit:
In passenger's footwell. The control unit is accessible when the shelf and side covering are removed.
- * Fuel accumulator:
On vehicle underbody between rear axle and fuel tank.
- * Pressure regulator:
Next to mixture-control unit in right-hand wheel arch.
- * Activated-carbon filter with tank-ventilation valve:
Next to mixture-control unit in right-hand wheel arch.
- * In-tank electric fuel pump:
Accessible from the luggage compartment.
For removal, take away luggage-compartment mat and unscrew round closing cover (3 screws).
- * Catalytic converter and lambda sensor:
In exhaust system, in the region behind the front axle.

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

AUDI 90:

- * EI-K control unit:
To the side in passenger's footwell, accessible when side panelling is removed.
- * Altitude sensor:
Above EI-K control unit.
- * KE control unit:
Behind the glove box, accessible when the lower panelling is removed.
(2 screws).
- * Injection valves:
Fitted as in AUDI 100, but access is difficult due to different configuration of intake manifold.
To improve accessibility, disconnect intake manifold at individual tubes.
- * Components of fuel-supply system:
Electric fuel pump, fuel accumulator and fuel filter are on vehicle underside, in the region in front of the rear axle.
- * Catalytic converter and lambda sensor:
In exhaust system in the region behind the front axle.
- * Activated-carbon filter:
On left-hand wheel arch; the tank-ventilation valve on the airscoop of the air-flow sensor.

Trouble-shooting instructions :

BOSCH system : Automatic heater and air conditioner (Tempmatik)

Make of vehicle : MB-5032

Basic microcard : MERCEDES-BENZ

TABLE OF CONTENTS

Section	Coordinates
Special features, safety, usage	MB-514
Trouble-shooting chart	03
How to use the self-diagnosis with test table	04
Test specifications	07
Electrical terminal diagram	15
Installation position of components	17

SPECIAL FEATURES

This microcard contains the trouble-shooting instructions for the electronic automatic heater and air conditioner (Tempmatik) in MERCEDES-BENZ vehicles

Type W 124: 200 D...300TE (09.87 ->)

Type C 124: 230CE...300CE (09.87 ->)

As of 09.87, the control unit of the Tempmatik has been integrated into the operating element. In addition, the control unit has been equipped with self-diagnosis.

A separate temperature sensor has been built into the systems for determining the engine temperature.

Activation of the auxiliary fan (speed 2) and of the fresh-air/circulating-air flap has been integrated into the control unit of the automatic heater and air conditioner. The switching points of the auxiliary fan are different for diesel-engined and spark-ignition-engined vehicles.

The air-conditioner switch has been changed. The "EC" push-button is no longer fitted. Instead, the fresh-air/circulating-air flap switch has been integrated into the air-conditioner switch. The "EC" function (air-conditioner compressor off) is selected if none of the air-conditioner push-buttons is actuated.

In the 200..230TE (4-cyl. engines) models, a double-contact relay for speed 1 of the auxiliary fan and a magnetic clutch for the engine fan have been installed instead of the polarized relay. In vehicles without electronic fuel induction (200 and 200T models), the idle speed is stabilized via a bypass valve when the refrigerant compressor is operating.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1.	No or poor heating effect
2.	No or poor cooling effect
3.	Heating blower cannot be regulated
4.	Incorrect air distribution
5.	Circulatory operation not possible
6.	Auxiliary fan is not switched in
7.	Idling problems on switching in the refrigerant compressor
Cause (component fault)	
*	Evaluate self-diagnosis
*	Coolant level too low
*	Check refrigerant level
*	Drier defective
*	Compacitor dirty
*	Auxiliary heating-water pump mechanically defective
*	Heating-water valve mechanically defective
*	Check control unit of compressor cutoff
*	Check TD signal to control unit of compressor cutoff
*	Check speed sensor of refrigerant compressor
*	Pressure switch defective
*	Compressor clutch defective
*	Belt drive loose

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. No or poor heating effect
2. No or poor cooling effect
3. Heating blower cannot be regulated
4. Incorrect air distribution
5. Circulatory operation not possible
6. Auxiliary fan is not switched in
7. Idling problems when switching in the refrigerant compressor

Cause (component fault)

*	*				Check blower switch
*	*				Series-resistor group of blower motor defective
*	*				Blower motor defective
	*			*	Auxiliary fan mechanically defective
				*	Check series resistor of auxiliary fan
*	*	*			Adjusting flaps mechanically defective
			*		Change-over valves mechanically defective
			*		Check switch of fresh-air flap/ circulating-air flap
*	*	*	*		Check vacuum system
*	*				Check sensor blower
*	*		*	*	Control unit defective
				*	Check activation lead to KE-Jetronic

For production reasons:
continued on the following
coordinate.

HOW TO USE THE SELF-DIAGNOSIS AND SELF-DIAGNOSIS TEST TABLE

Installed in this vehicle is a control unit which has a self-diagnosis facility. Therefore trouble-shooting must always be started with self-diagnosis.

The indicated faults in the automatic heater and automatic air conditioner are broken down in the self-diagnosis test table which starts on coordinates A09. The self-diagnosis test table contains fault indication, component tested, test terminals at control-unit plugs, cause of trouble, test instructions and set values.

The trouble-shooting charts starting on coordinates A04 should be used only if a customer complaint has been received and there is no fault stored in the fault memory. Listed in the trouble-shooting charts are only those components which are not tested by the self-diagnosis facility.

Activating the self-diagnosis:

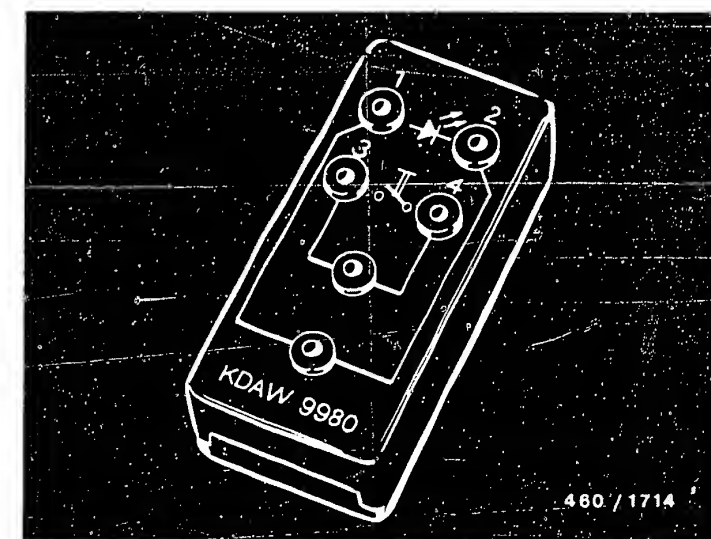
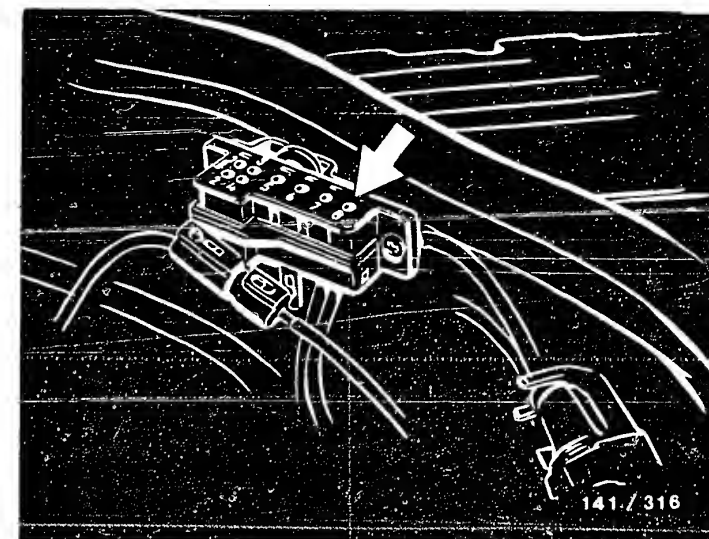
Connect sockets 2 and 4 of the flashing-code evaluation unit KDAW 9980 to socket 7 of the test coupling for diagnosis (upper illustration, arrow). Connect evaluation-unit socket 1 to battery +ve and socket 3 to ground (socket 1 of diagnostic coupling). Switch on ignition. Press push-button on evaluation unit for approx. 1 s. Output of the self-diagnosis begins approx. 2 s. after stimulation with the first flashing code. Each flashing code consists of a flashing-pulse block with 1 to 57 flashing pulses.

Continuing diagnosis:

After a fault has been read out, the next fault is output by pressing the push-button again. Continue diagnosis until the fault output first of all is repeated. Diagnosis output can be ended only by switching off the ignition.

Note :

During diagnosis output, the LED in the fresh-air/circulation-air switch flashes. If the control unit cannot be stimulated into outputting diagnosis, check whether the voltage supply of the control unit and the diagnostic lead from control unit term. 15 to the diagnostic test coupling socket 7 is open-circuited.



SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
1	Control unit and periphery	No fault present in system.	—	—
3	Passenger-compartment temperature sensor, open circuit	Check resistance of passenger-compartment temperature sensor: at 10°C: at 45°C: Check leads for short circuit and open circuit.	9 21	Approx. 18,3...21,5 k Ω
2	Passenger-compartment temperature sensor, short circuit		9 21	Approx. 3,5... 4,5 k Ω
5	Ambient-temp. sensor, open circuit	Check resistance of ambient-temperature sensor: at 10°C: at 45°C: Check leads for short circuit and open circuit.	10 21	Approx. 5,0... 6,0 k Ω
4	Ambient-temp. sensor, short circuit		10 21	Approx. 1,1... 1,3 k Ω
7	Evaporator-temperature sensor, open circuit	Check resistance of evaporator-temperature sensor: at 0°C: at 45°C:	13 21	Approx. 30,0...35,0 k Ω
6	Evaporator-temperature sensor, short circuit		13 21	Approx. 3,5... 4,5 k Ω
9	Discharge-temperature sensor, left, open circuit	Check resistance of discharge-temperature sensor, left: at 10°C: at 45°C: Check leads for short circuit and open circuit.	11 21	Approx. 18,3...21,5 k Ω
8	Discharge-temperature sensor, left, short circuit		11 21	Approx. 3,5... 4,5 k Ω

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instruction/Test conditions	Terminals	Set values
11	Discharge-temperature sensor, right, open circuit	Check resistance of discharge-temperature sensor, right: at 10°C:	12 21	Approx. 18,3...21,5 k Ω
10	Discharge-temperature sensor, right, short circuit	Check leads for short circuit and open circuit.	12 21	Approx. 3,5... 4,5 k Ω
13	Coolant-temperature sensor, open circuit	Check resistance of temperature sensor (coolant): at 20°C:	14 21	5,0... 8,0 k Ω
12	Coolant-temperature sensor, short circuit	Check leads for short circuit and open circuit.	14 21	300... 400 Ω
30	Auxiliary heating-water pump, short circuit, open circuit	Switch on ignition. Check supply voltage of auxiliary heating-water pump: Check leads for short circuit and open circuit. (Actuate "DEF" push-button, Heating-water pump must run.)	1 20	Greater than 10 V
31	Duo heating-water valve left, short-circuit or open circuit	Switch on ignition. Check supply voltage of heating-water valve, left: Check leads for short circuit and open circuit.	2 20	Greater than 10 V
32	Duo heating-water valve right, short circuit or open circuit	Switch on ignition. Check supply voltage of heating-water valve, right: Check leads for short circuit and open circuit.	3 20	Greater than 10 V
33	Control unit of compressor cutoff, short circuit	Switch on ignition. Check supply voltage of compressor-cutoff device: (Note: output signal can be tested only when compressor-cutoff device is connected). Check contacts of compressor-cutoff device (corrosion or lead fallen off). Check leads for short circuit and open circuit.	4 20	Greater than 10 V

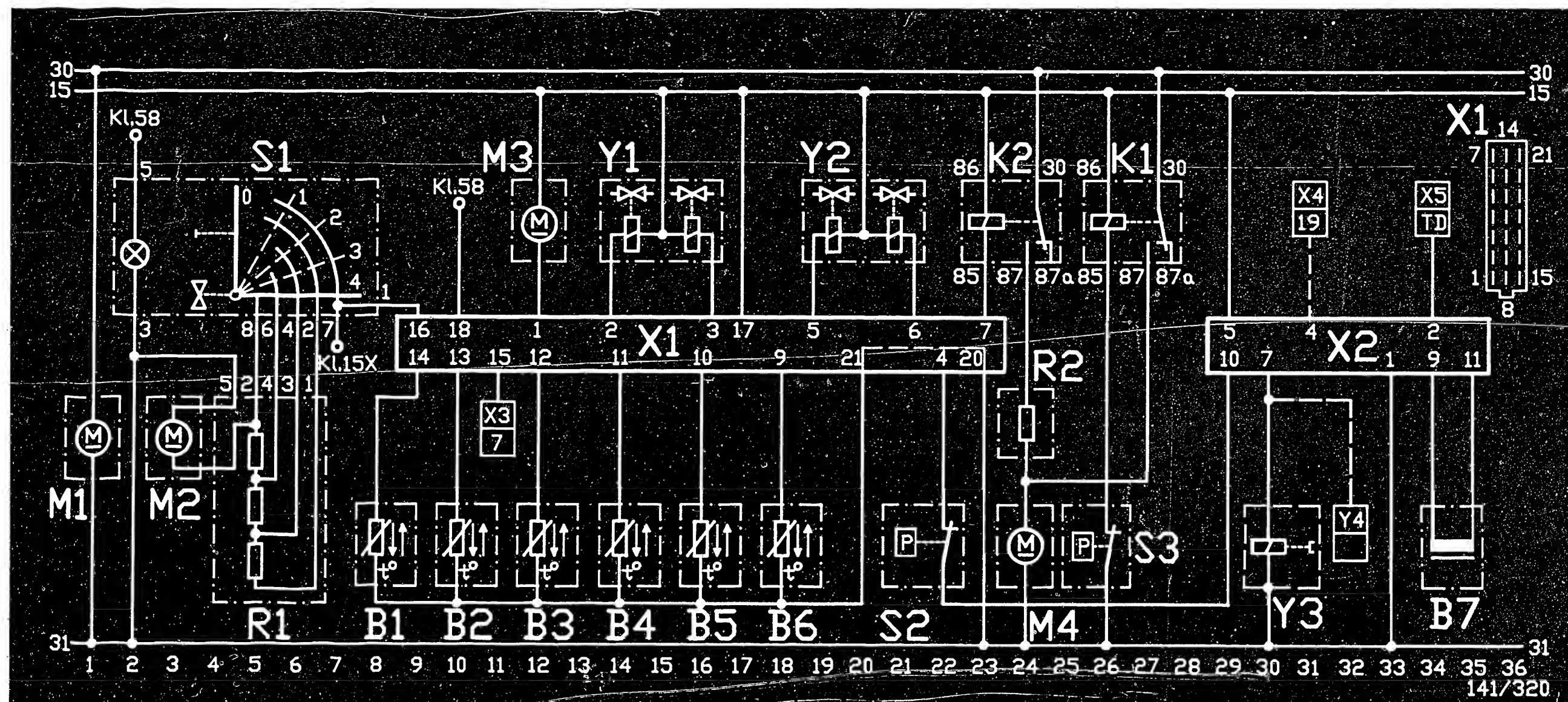
SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
34	Auxiliary fan, short circuit or open circuit	Switch on ignition. Check supply voltage of auxiliary-fan relay: Check leads for short circuit and open circuit.	7 20	Greater than 10 V
56	Circulating-air-flap change-over valve: large stroke, short circuit or open circuit	Switch on ignition. Check supply voltage of change-over valve: Check leads for short circuit and open circuit.	5 20	Greater than 10 V
57	Circulating-air-flap change-over valve: small stroke, short circuit or open circuit	Switch on ignition. Check voltage supply of change-over valve: Check leads for short circuit and open circuit.	6 20	Greater than 10 V

TEST SPECIFICATIONS

	Internal resistance
Passenger-compartment temperature sensor	21,5...3,5 k Ω at 10...45 °C
Discharge-temperature sensor	21,5...3,5 k Ω at 10...45 °C
Evaporator-temperature sensor	35...3,5 k Ω at 0...45 °C
Ambient-temperature sensor	6,0...1,1 k Ω at 10...45 °C
Heating-water valve	Approx. 10... 20 Ω
Coolant-temperature sensor	Approx. 5,0...0,3 k Ω at 20...100 °C
Change-over-valves internal resistance	Approx. 50... 80 Ω
Heating-water-pump power consumption:	Max. 1 A
	Switching points
Low-pressure switch, compressor	Off at 2,0 bar On at 2,6 bar
High-pressure switch, compressor	Off at 30 bar On at 22 bar
Pressure switch, auxiliary fan	Off at 15 bar On at 20 bar

For production reasons:
continued on the following
coordinate.



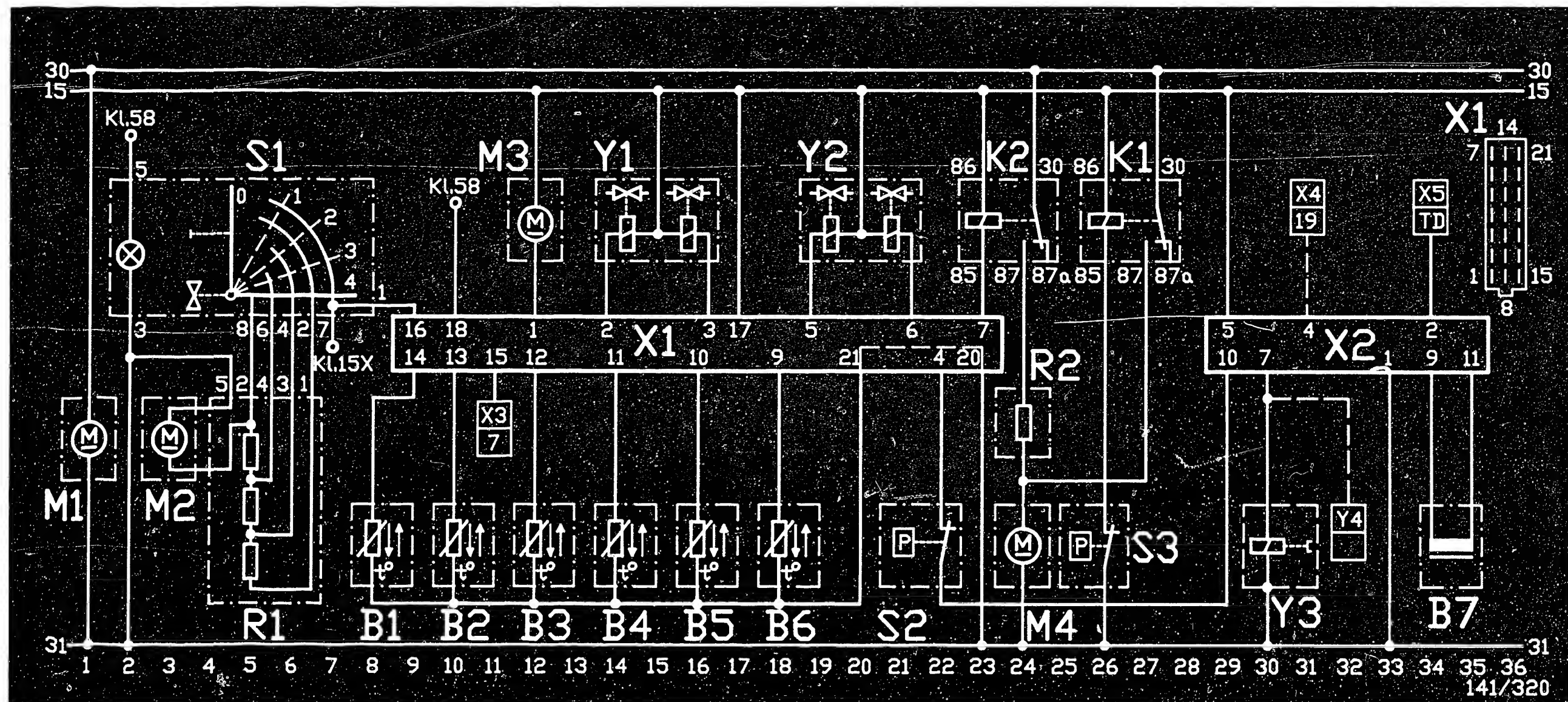
B1 = Coolant-temperature sensor
 B2 = Evaporator-temperature sensor
 B3 = Discharge-temperature sensor, right
 B4 = Discharge-temperature sensor, left
 B5 = Ambient-temperature sensor
 B6 = Passenger-compartment temperature sensor
 B7 = Speed sensor, refrigerant compressor

K1 = Relay, series resistor of auxiliary fan
 (double-contact relay for magnetic
 clutch of engine fan in 200...230TE models)
 K2 = Relay, auxiliary fan
 M1 = Passenger-compartment sensor of ventilation blower
 M2 = Blower motor
 M3 = Heating-water pump
 M4 = Auxiliary fan

ELECTRICAL TERMINAL DIAGRAM - TEMPMATIK (VEHICLES WITH SPARK-IGNITION ENGINE)

| K17 | ————— | ==> |

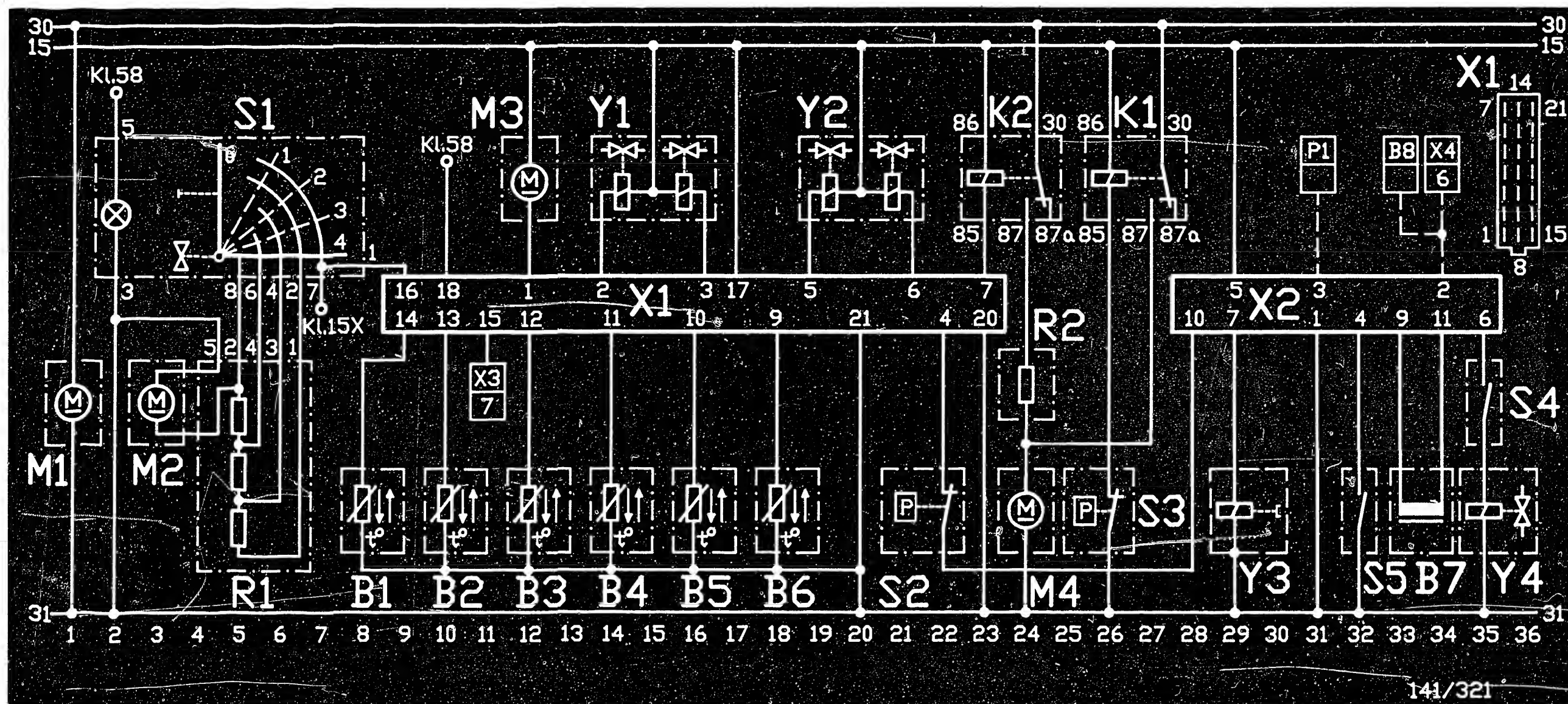
| K18 | ————— | <== |



R1 = Series-resistor group, blower
 R2 = Series-resistor, auxiliary fan
 S1 = Air-flow switch
 S2 = Pressure switch, refrigerant compressor
 S3 = Pressure switch, auxiliary fan
 X1 = Control-unit plug of Tempmatik with
 operating element (term. 21 and term. 22
 connected internally in control unit)

X2 = Plug, control unit of compressor cutoff
 X3 = Test coupling for diagnosis
 X4 = Plug, control unit of KE-Jetronic (Ecotronic)
 X5 = Plug, EI/TI control unit
 Y1 = Duo heating-water valve
 Y2 = Change-over valve, fresh-air/circulating-air flap
 Y3 = Magnetic clutch, refrigerant compressor
 Y4 = Bypass valve

ELECTRICAL TERMINAL DIAGRAM - TEMPMATIK (VEHICLES WITH SPARK-IGNITION ENGINE) (CONTINUED)



B1 = Coolant-temperature sensor
 B2 = Evaporator-temperature sensor
 B3 = Discharge-temperature sensor, right
 B4 = Discharge-temperature sensor, left
 B5 = Ambient-temperature sensor
 B6 = Passenger-compartment temperature sensor

B7 = Speed sensor, refrigerant compressor

B8 = Speed sensor (only 4-cyl. engine with manual transmission)

ELECTRICAL TERMINAL DIAGRAM - TEMPMATIK (Vehicles with diesel engine)

K1 = Relay, auxiliary-fan series resistor
 (double-contact relay in 200D...200TD)

K2 = Relay, auxiliary fan

M1 = Passenger-compartment sensor, ventilation blower

M2 = Blower motor

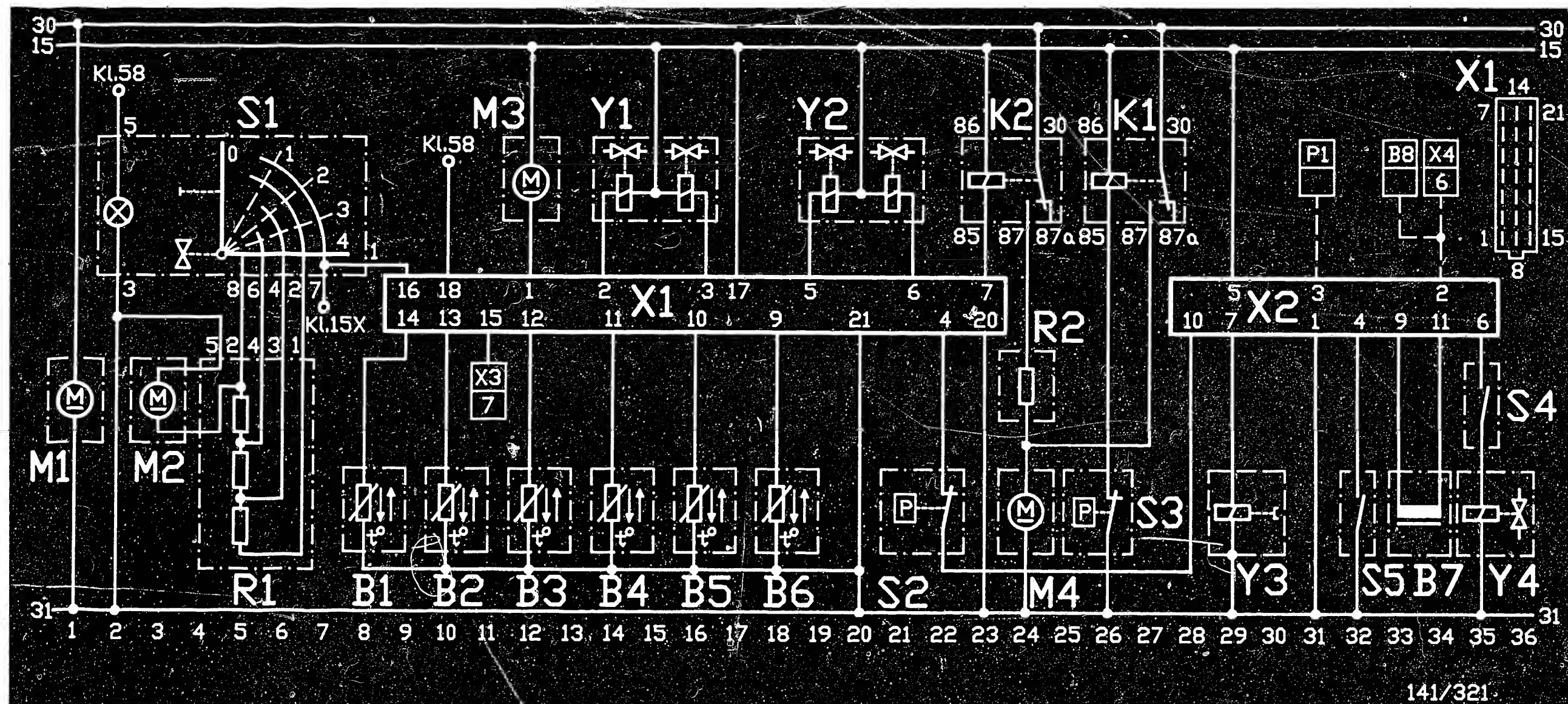
M3 = Heating-water pump

M4 = Auxiliary fan

P1 = Tachometer

K21

K22



R1 = Series-resistor group, blower
 R2 = Series-resistor, auxiliary fan
 S1 = Air-flow switch
 S2 = Pressure switch, refrigerant compressor
 S3 = Pressure switch, auxiliary fan
 S4 = Kickdown switch (automatic transmission only)
 S5 = Microswitch, compressor cutoff
 (automatic transmission only)

ELECTRICAL TERMINAL DIAGRAM - TEMPMATIK (Vehicles with diesel engine)

X1 = Control-unit plug of Tempmatik with operating element
 X2 = Plug, control unit of compressor cutoff
 X3 = Test coupling for diagnosis
 X4 = Plug, control unit of low-idle speed control/
 active bucking damping
 Y1 = Duo heating-water valve
 Y2 = Change-over valve, fresh-air/circulating-air
 Y3 = Compressor clutch
 Y4 = Change-over valve, automatic transmission

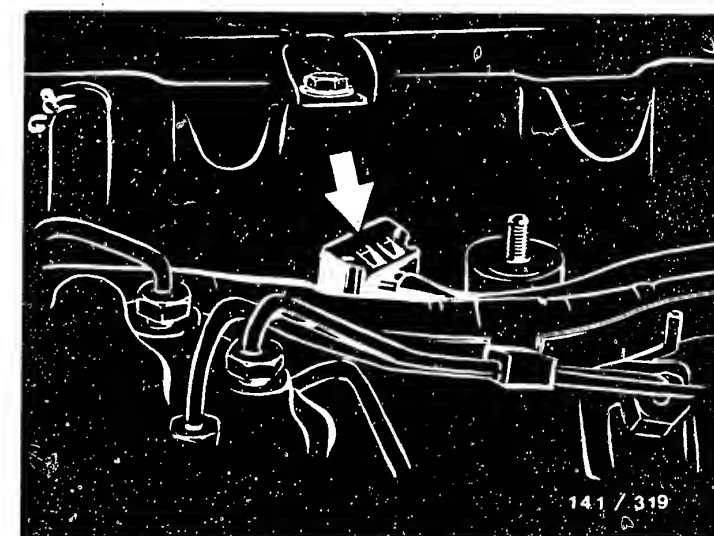
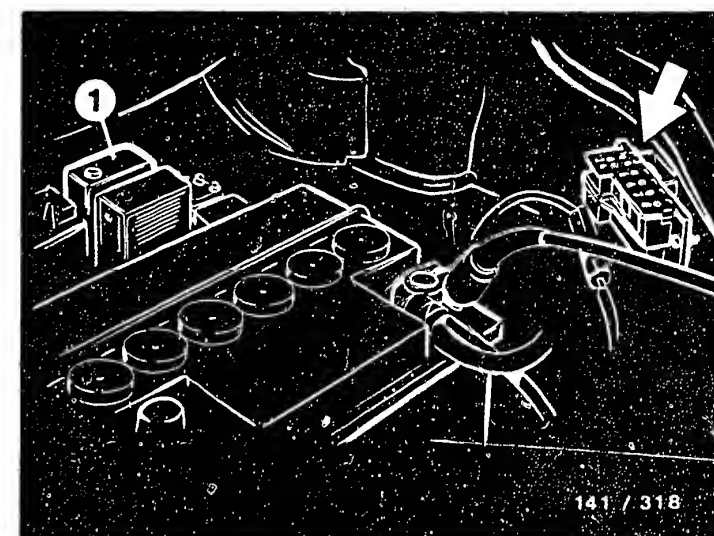
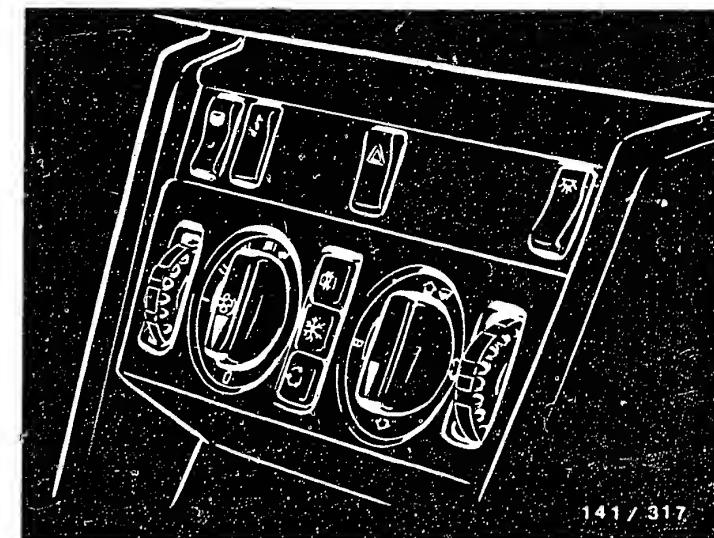
INSTALLATION POSITION OF COMPONENTS

The electronic control unit in this system is integrated into the operating element (upper illustration).
The test coupling for diagnosis is installed in the engine compartment next to the heating-water valve (center illustration, arrow).

The control unit for compressor cutoff is installed in the engine compartment (center illustration, 1).

The coolant-temperature sensor is mounted on the cylinder head (lower illustration, arrow).

The installation positions of the remaining components have not changed compared with those given in the basic instructions.



Trouble-shooting instructions : VWW-5005
BOSCH system : L2-Jetronic
Make of vehicle : VW
Basic microcard : VWW-503

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SPECIAL FEATURES

These brief instructions apply to the following vehicle models with 1.272 l/4-cyl. engine, valid at the time of writing:

VW Golf Injection	4.87 ->
VW Jetta Injection	4.87 ->
VW Polo Injection	4.87 ->
Engine code letters NZ	D,S,CH version
Engine code letters RC	A version

- * L2-Jetronic with 25-pin control unit:
0 280 000 542/543
- * Engine-speed tripping from term. 7 of TCI trigger box
- * 4-pin air-flow sensor
- * Solenoid-operated injection valves with brass-wire coil.
- * Starting control
- * Throttle-valve switch with double cam for idle and full load
- * In-tank pre-supply pump
- * Lambda closed-loop control with heated sensor.
- * 3-way exhaust-gas catalytic converter
- * For testing fuel pressure, connect pressure gauge with connecting piece KDJE-P 100/13 in circuit at fuel-distribution-pipe inlet.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel when testing the compression.
To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, fuel injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

										Cause (component fault)
*	*	*	*	*	*	*	*	*	*	Universal test adapter
*										Electric fuel pump
*	*	*	*							Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*	*		Air-flow sensor/air-mass sensor
*	*	*	*		*					Intake system
		*	*	*		*	*			Solenoid-operated injection valves
*	*	*			*	*				Fuel pressure
				*	*					Fuel quantity
		*	*	*	*	*				Throttle valve
			*							Overrun cut-off
*		*								Start control
			*							Ground
*	*	*	*	*	*					Alternator, interference suppress.
		*	*	*		*				CO exhaust-gas adjustment
			*							Control unit
					*					Catalytic converter
	*	*	*	*						Lambda closed-loop control

RAPID DIAGNOIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter cable: 1 684 463 156

Test step	Switch V	Ω	Terms.	Inspection of component/function	Test instructions/ Test conditions	Set values
1	4	-	21 - 7 (+) (-)	Voltage from ignition and starting switch term. 50	Disengage gear, start engine	8...15 V
2	5	-	1 - 7 (+) (-)	TD signal from TCI trigger box term. 7	Disengage gear, start engine	Ignition pulses on oscilloscope
3	6	-	13 - 7 (+) (-)	Voltage from main relay term. 87	Ignition "ON"	8...15 V
4	7	-	20 - 7 (+) (-)	Voltage from pump relay term. 86	Ignition "ON"	8...15 V
5	 V	5	2 - 7	Resistance, temperature sensor (engine)	+15...+30°C: approx. +80°C :	1,3...3,6 k Ω 250...390 Ω
6	 V	6	14 - 7 (6)	Resistance, temperature sensor (intake air)	+15...+30°C: approx. +80°C :	1,3...3,6 k Ω 250...390 Ω
7	 V	7	15 - 7 (6)	Resistance of potentiometer in air-flow sensor	Deflect air-flow sensor flap to the stop	8...1000 Ω
8	 V	8	19 - 7 (6)	Resistance in air-flow sensor		500...800 Ω
9	 V	9	4 - 7	Resistance of throttle-valve switch	Accelerator pedal in rest position: Accelerator pedal slightly depressed: Accelerator pedal fully depressed:	0...10 Ω Infinity Ω 0...10 Ω

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
 Adapter cable: 1 684 463 156

Test step	Switch		Terms.	Inspection of component/function	Test instructions/ Test conditions	Set values
	V	Ω				
10	I V	11	25 - 7	Ground connection of output stage		0...10 Ω
11	I V	12	12 - 7	Resistance of 1st injection valve and electric fuel pump	+15...+30°C : Approx. +80°C :	17,7...22 Ω 19,7...24,5 Ω
12	I V	13	11 - 7	Resistance of 2nd injection valve and electric fuel pump	+15...+30°C : Approx. +80°C :	17,7...22 Ω 19,7...24,5 Ω
13	I V	14	24 - 7	Resistance of 3rd injection valve and electric fuel pump	+15...+30°C : Approx. +80°C :	17,7...22 Ω 19,7...24,5 Ω
14	I V	15	23 - 7	Resistance of 4th injection valve and electric fuel pump	+15...+30°C : Approx. +80°C :	17,7...22 Ω 19,7...24,5 Ω

TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pumps	
* Fuel delivery at return:	min. 500 cm ³ /30 s
* Supply voltage under load:	min. 12 V
* Fuel delivery of in-tank pre-supply pump	min. 600 cm ³ /30 s
Pressure regulator	
* Fuel pressure with engine at standstill:	2,3...2,7 bar
at idle:	approx. 0.5 bar lower
Fuel system, leakages	
* Fuel pressure after engine stationary for 20 min.:	min. 1.0 bar
Auxiliary-air device	
* Resistance value	25...60 Ω
Air-flow sensor	
* Resistance value between term. 2 and term. 4:	8...1000 Ω 1)
term. 3 and term. 4:	500... 800 Ω
1) (Fully deflect air-flow sensor flap)	
Temperature sensor (engine)	
* Electrical internal resistance at ambient temperature +15...+30°C:	1,3...3,6 k Ω
with eng. at op. temperature approx. +80°C :	250...390 Ω

TEST SPECIFICATIONS (continued)

Component/function	Set values
Temperature sensor (intake air)	
* Electrical internal resistance at ambient temperature +15...+30°C:	1,30...3,6 k Ω
with eng. at op. temperature approx. +80°C :	250...390 Ω
Solenoid-operated inj. valve	
* Electrical internal resistance at ambient temperature +15...+30°C:	14.5...17.5 Ω
* Leakages after 60 s:	no drop may fall
Starting control	
* Voltage at injection valve on initiation of starting:	above 1.5 V
after approx. 15s:	approx. 0.5 V
Lambda-sensor heating	
* Electrical int. resistance (PTC) with eng. at standstill:	1...15 Ω
Idle adjustment	
Eng. at op. temp., approx.+80°C	
* Idle speed:	750...850 min ⁻¹
* CO content:	0,3...1,1 % by vol.
Measuring point: on exhaust pipe, left.	
To do this, take apart lambda-sensor plug and detach hose for crankcase ventilation.	
If required, use VW adapter V.A.G 1506.	

For settings for ignition, valve clearance and other technical engine data refer to equipment and autodata microcard.

TEST SPECIFICATIONS (CONTINUED)

Lambda closed-loop control

Measure CO content upstream of catalytic converter. To do this, run engine (at operating temperature) in part-load range (approx. 2500 min⁻¹).

* Rich value

Take apart lambda-sensor plug and connect to ground on control-unit side (pin 1, lower illustration).
CO content:

rises to above 1,1 % by

vol.

Make the measurement brief to spare the catalytic converter.

* Lean value

Connect 2 V to sensor lead on control-unit side (pin 1, lower illustration).
CO content:

drops below 0,3 % by vol.
Engine runs irregularly

* Closed-loop control value

Reconnect sensor plug.
CO content:

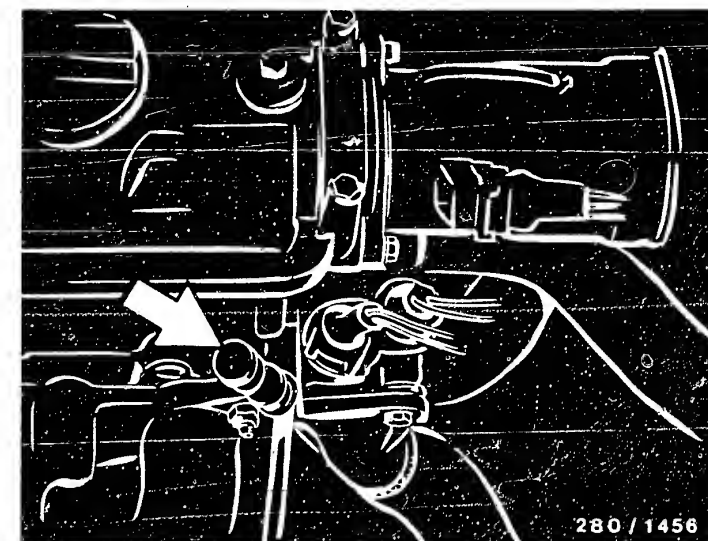
0,3...1,1 % by vol.

Detach intake-manifold-pressure actuator (air hose) at pressure regulator.

CO content:

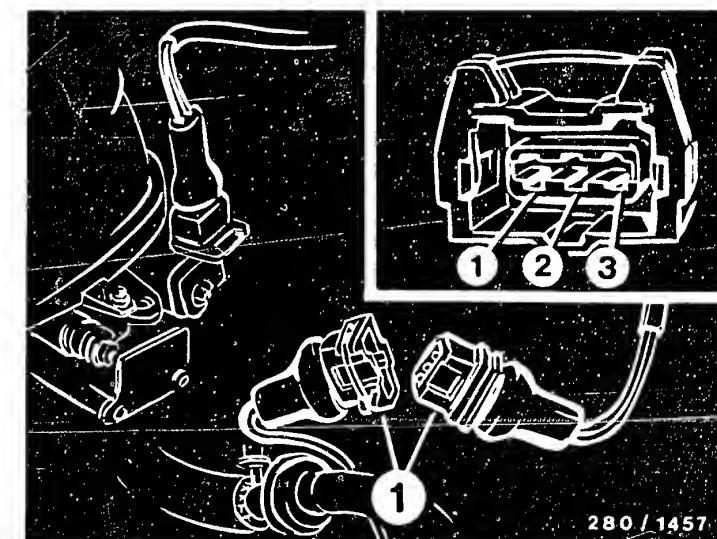
rises briefly and then drops back to the above closed-loop control value.

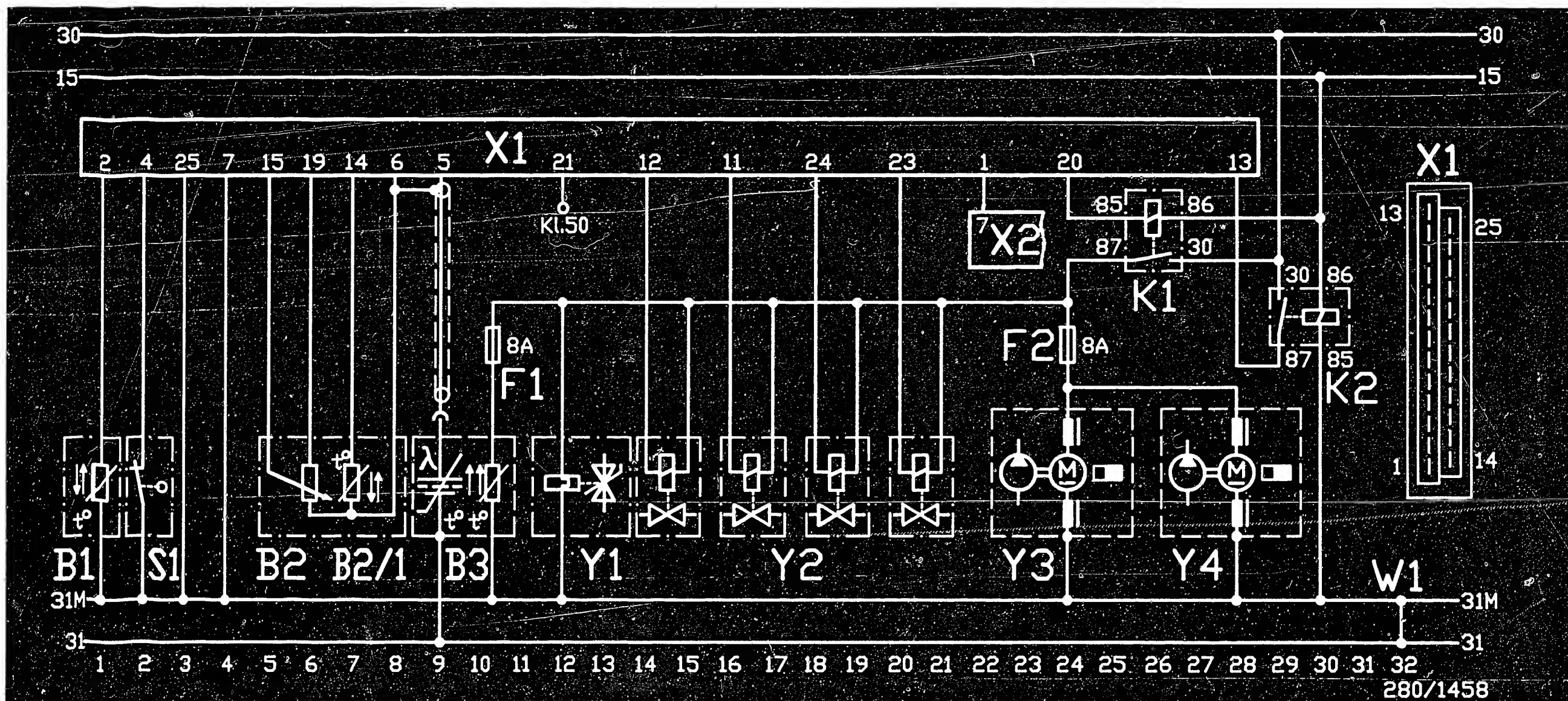
Switch off extraction system for the duration of measuring and setting exhaust gas.



1 = CO sampling point

1 = Lambda-sensor plug

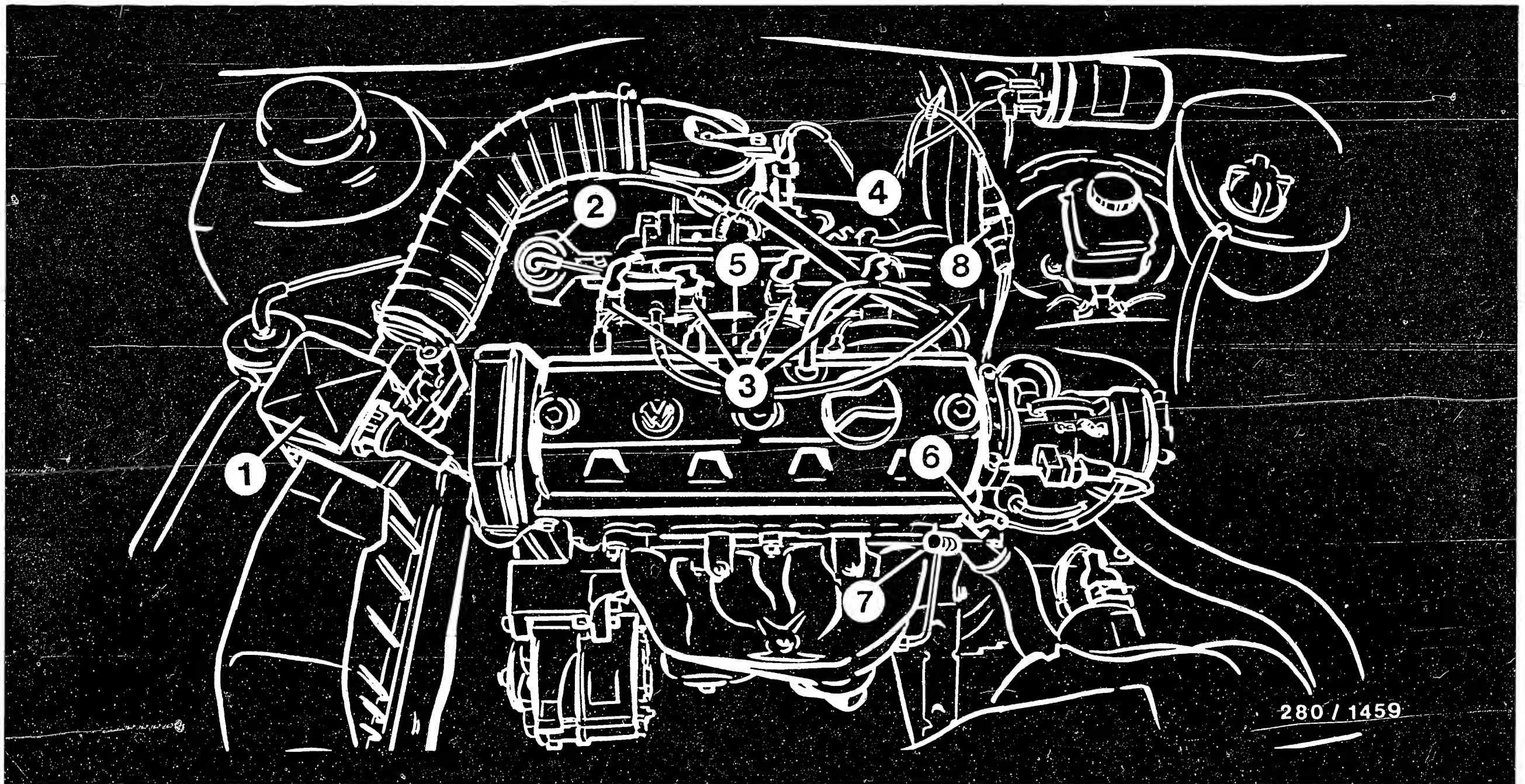




B1 = Temperature sensor (engine)
 B2 = Air-flow sensor
 B2/1 = Temperature sensor (intake air)
 B3 = Lambda sensor (heated)
 F1 = Fuse (sensor heating)
 F2 = Fuse (electric fuel pump)
 K1 = Pump relay
 K2 = Main relay

S1 = Throttle-valve switch
 W1 = Ground strap, engine
 X1 = Control-unit plug
 X2 = Ignition-control-unit plug
 Y1 = Auxiliary-air device
 Y2 = Solenoid-operated injection valves
 Y3 = In-tank electric fuel pump
 Y4 = In-tank pre-supply pump

ELECTRICAL TERMINAL DIAGRAM

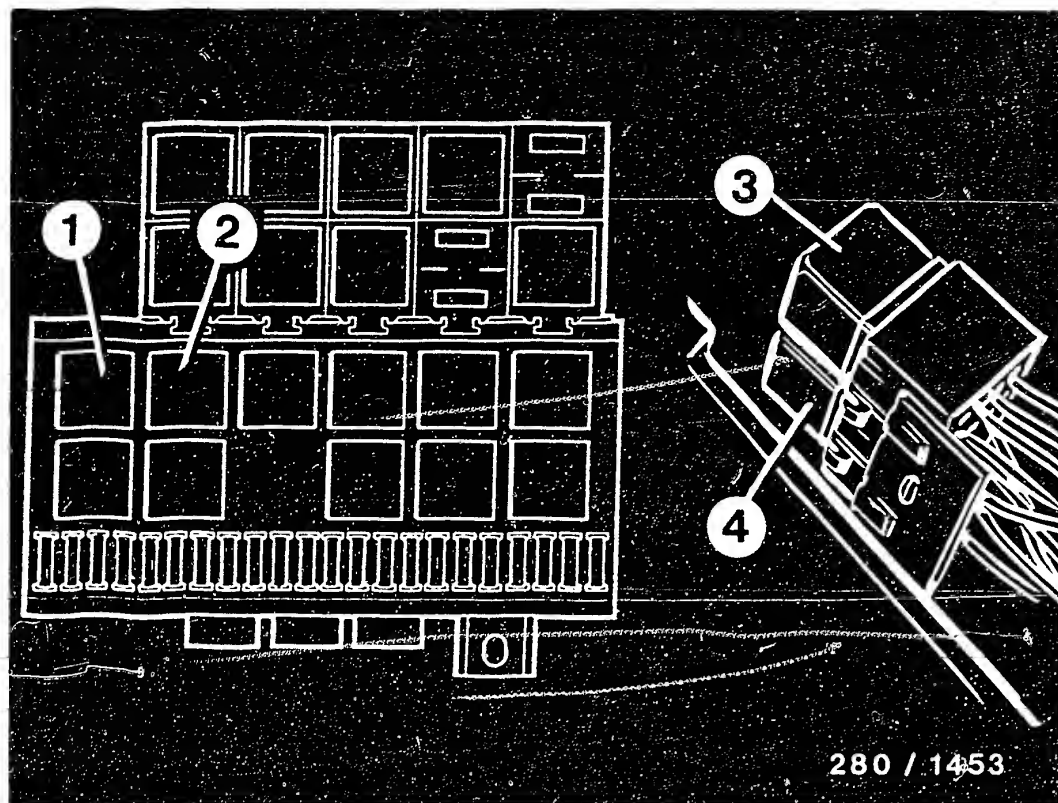


280 / 1459

- 1 = Air-flow sensor
- 2 = Pressure regulator
- 3 = Solenoid-operated injection valves
- 4 = Throttle-valve switch

- 5 = to auxiliary-air device
- 6 = Temperature sensor (engine)
- 7 = CO sampling point
- 8 = Lambda-sensor plug

INSTALLATION POSITION OF COMPONENTS



- 1 = Main relay
- 2 = Pump relay
- 3 = Pump relay (Polo)
- 4 = Main relay (Polo)

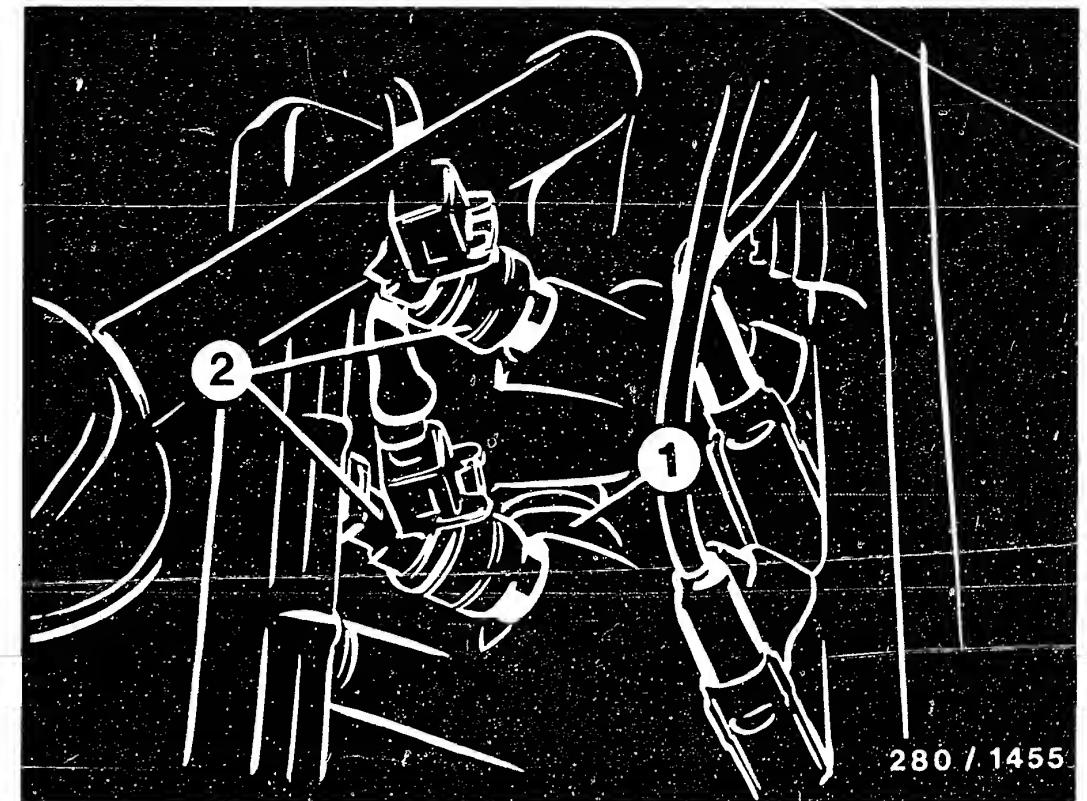
All details of installation positions always refers to the forward direction of travel.

In the Golf model both relays are located on the left at the bottom on the driver's side.

In the Polo model both relays are located on the left at the front in the radiator tank, in the vicinity of the control unit.

Other components not shown

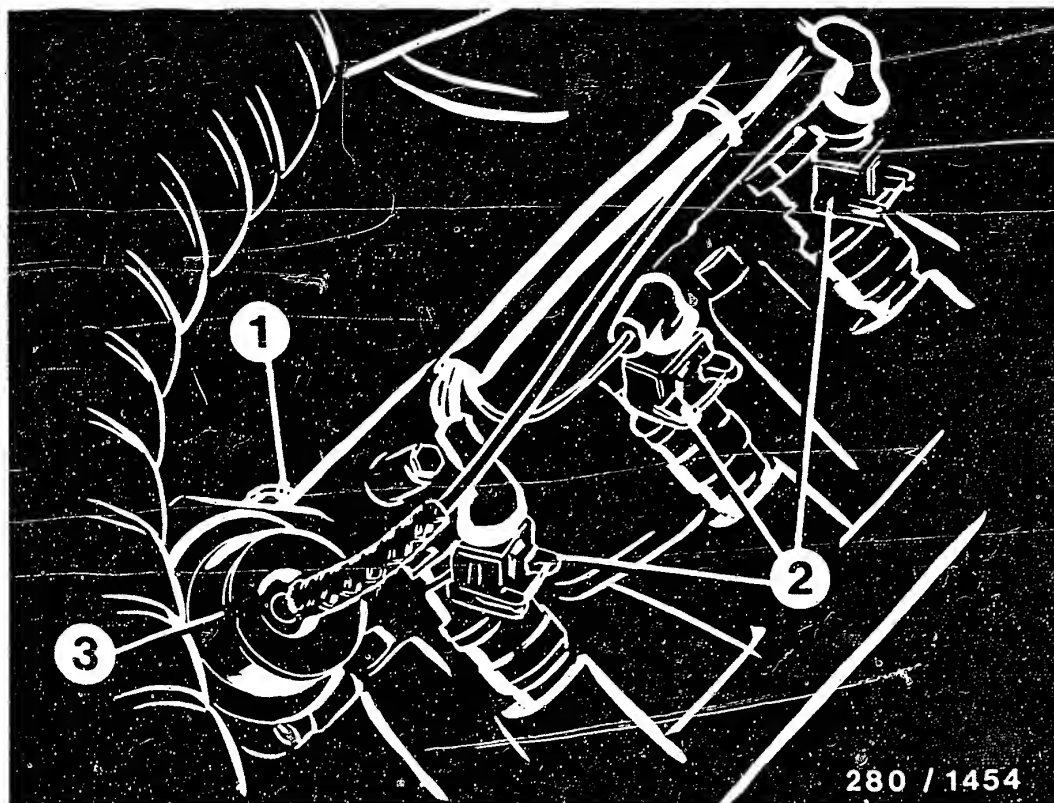
- * Lambda sensor is screwed into exhaust pipe upstream of catalytic converter.



- 1 = Auxiliary-air device
- 2 = Solenoid-operated injection valves

Other components not shown

- * Electric fuel pump, in Golf model as in-tank pump, is located in pump accumulator on the right at the bottom in front of the rear axle.
- * In-tank pre-supply pump in Golf model is combined with tank indicator and accessible via a cover above the fuel tank.
- * Electric fuel pump in Polo model is located on the right at the bottom behind the rear axle.
- * In-tank pre-supply pump in Polo model is fitted in same position as in Golf model.
- * Central ground is connected to the ground terminal of the battery.



- 1 = Pressure-measuring connection
- 2 = Solenoid-operated injection valves
- 3 = Pressure regulator

FUEL-PRESSURE TEST

To test pressure, use pressure gauge and hose of pressure-measuring device KDJE-P 100.

Insert connecting piece KDJE-P 100/13 at fuel-distribution-pipe inlet and connect hose to pressure gauge at lateral threaded connector.

Caution. When opening the screw connection take care that no fuel comes into contact with hot engine parts.

For production reasons:
continued on the following
coordinate.

Trouble-shooting instructions : ALF-5008
BOSCH system : L-Jetronic
Make of vehicle : ALFA-ROMEO
Basic microcard : FIA-01/J22

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models with 2.959 1/6-cyl. engine:

Alfa 75 3.0 V6 Iniezione 1.87->

- * L-Jetronic with 35-pin control unit:
0 280 001 133.
- * Engine-speed triggering from term. 1 of the ign. coil.
- * 7-pin air-flow sensor with pump contact.
- * 13-pin relay set.
- * 2.5 Ω solenoid-operated injection valves, control unit with current-controlled output stage.
- * Starting enrichment by means of cold-start valve and thermo-time switch.
- * Pressure sensor for altitude compensation.
- * For testing the fuel pressure, connect pressure tester with 3-way line KDJE-P 100/13 to the cold-start valve.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* When testing the compression, avoid the injection of fuel.
Therefore, disconnect relay set.

For further precautionary measures, see basic instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, fuel injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)										
*	*	*	*	*	*	*	*	*	*	Universal test adapter
*										Electric fuel pump
*	*	*	*							Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*	*		Air-flow sensor/air-mass sensor
*	*	*	*		*					Induction system
		*	*	*		*	*			Solenoid-operated injection valves
*	*	*			*	*				Fuel pressure
				*	*					Fuel quantity
		*	*	*	*	*				Throttle valve
*	*	*				*				Cold-start valve
*		*								Thermo-time switch
				*						Frame connection
*	*	*	*	*	*					Alternator, interference-suppress.
		*	*	*		*				CO-exhaust-gas adjustment
			*							Control unit

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 129

Test step	switch		Terminals	Testing of component/function	Test instructions / Test conditions	Set values
	V	Ω				
1	3	—	4 - 5 (+) (-)	Voltage from ignition and starting switch term. 50	Shift into neutral, start engine	8...15 V
2	4	—	34 - 5 (+) (-)	Voltage from relay set term. 88c via auxiliary-air device	Shift into neutral, start engine	8...15 V
3	5	—	1 - 5 (+) (-)	Voltage pulses from ignition coil term. 1	Shift into neutral, start engine	Ignition pulses on oscilloscope
4	6	—	10 - 5 (+) (-)	Voltage from relay set term. 88a	Switch on ignition	8...15 V
5	7	—	15 - 5 (+) (-)	Voltage of injection valve 1	Switch on ignition	8...15 V
6	8	—	33 - 5 (+) (-)	Voltage of injection valve 2	Switch on ignition	8...15 V
7	9	—	32 - 5 (+) (-)	Voltage of injection valve 3	Switch on ignition	8...15 V
8	10	—	14 - 5 (+) (-)	Voltage of injection valve 4	Switch on ignition	8...15 V
9	11	—	20 - 5 (+) (-)	Voltage over pump contact in air-flow sensor from relay set term. 86b	Switch on ignition	8...15 V

M05

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M06

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RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (Continued)

Adapter lead: 1 684 463 129

Test step	switch V	Ω	Terminals	Testing of component/function	Test instructions / Test conditions	Set values
10	12	-	29 - 5 (+) (-)	Voltage from relay set term. 88b	Switch on ignition	8...15 V
11	13	-	30 - 5 (+) (-)	Voltage of injection valve 5	Switch on ignition	8...15 V
12	14	-	31 - 5 (+) (-)	Voltage of injection valve 6	Switch on ignition	8...15 V
13	 V	6	7 - 5	Resistance value of potentiometer wiper in air-flow sensor	Deflect air-flow sensor flap as far as it will go	80...600 Ω
14	 V	7	8 - 5	Resistance value of potentiometer (total) in air-flow sensor		260...520 Ω
15	 V	8	9 - 5	Resistance value of both resistors in series in air-flow sensor	Disconnect 3-pin cable connector from pressure sensor (altitude sensor).	400...800 Ω
16	 V	9	2 - 18	Resistance value of idle contact	Connect cable connector on to pressure sensor. Disconnect EI control-unit plug. Accelerator pedal in idle position: Slightly depress accelerator pedal:	0...10 Ω infinity Ω
17	 V	10	3 - 18	Resistance value of full-load contact	EI control-unit plug remains disconnected. Accelerator pedal in idle position: Depress accelerator pedal to floor.	infinity Ω 0...10 Ω

RAPID DIAGNOIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (Continued)
Adapter lead : 1 684 463 129

Test step	Switch	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
18	 V	11	27 - 5	Resistance, air-intake temperature sensor	+15...30 °C : 1.45...3.3 k Ω
19	 V	12	13 - 5	Resistance, engine-temperature sensor	+15...30 °C : Approx. +80 °C : 1.3...3.6 k Ω 250...390 Ω
20	 V	13	16 - 5	Frame connection of output stage	0...10 Ω
21	 V	14	17 - 5	Frame connection of output stage	0...10 Ω
22	 V	15	35 - 5	Frame connection of output stage	0...10 Ω
23	 V	8	9 - 5	Resistance value of pressure sensor	Disconnect 7-pin cable connector from air-flow sensor. 2.3...2.8 k Ω
24	 V	19	12 - 5	Resistance value of pressure sensor, wiper	At 977 mbar (approx.300 m altitude): At 616 mbar (approx.4000 m altitude): After the measurement, reconnect 7-pin cable connector to air-flow sensor. 2.0...2.5 k Ω 2.2...2.7 k Ω

REMARK : The following components with their respective connection leads are not covered in the test by the universal test adapter:

1. Electric fuel pump(s):
2. Cold-start valve:
3. Thermo-time switch:
- positive lead from term. 88d of the relay set,
positive lead from term. 86 of the relay set,
at term. G, positive from term. 86 of the relay set,
- negative lead to vehicle ground.
negative lead to thermo-time switch term. W.
thermo-time-switch housing to engine ground.

TEST SPECIFICATIONS

Component/Function	Set values
Electric fuel pump	
* Fuel delivery at return:	at least 900 cm ³ /30 s
* Supply voltage under load:	at least 12 V
In-tank pre-supply pump (if fitted)	
* Fuel delivery:	at least 1000 cm ³ /30 s
Pressure regulator	
* Fuel pressure: with engine at standstill at idle:	2,3...2,7 bar approx. 0.5 bar lower
Fuel system, leakage	
* Fuel pressure after 20 mins with engine at standstill:	at least 1.0 bar
Temperature sensor (air intake)	
On air-flow sensor at term.6 and term.27	
* Internal electrical resistance at ambient temperature +15...+30°C :	1,45...3,3 k Ω
Temperature sensor (engine)	
* Internal electrical resistance at ambient temperature +15...+30°C :	1,30...3,6 k Ω
with eng. at norm. op. temp. approx. +80°C :	250...390 Ω

TEST SPECIFICATIONS (Continued)

Component/function	Set values
Auxiliary-air device	
* Internal electrical resistance:	25... 60 Ω
Air-flow sensor	
* Resistance between	
term. 6 and term. 9:	400... 800 Ω
term. 6 and term. 8:	260... 520 Ω
term. 6 and term. 7:	
(Fully deflect air-flow sensor flap)	80... 600 Ω
term. 7 and term. 8:	200...1000 Ω
term. 8 and term. 9:	140...280 Ω
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature +15...+30°C:	2,0...3,0 Ω
* Leakage after 60 s:	no drop must fall
Pressure sensor (altitude sensor)	
* 300 m altitude (977mbar):	2,0...4,0 V
4000m altitude (616mbar):	8,0...12,0 V
Resistance between	
term. 2 (-) and term. 3 (+):	2,3...2,8 k Ω
Relay set	
* Electrical resistance between term. 85 and term. 86b:	70...500 Ω

TEST SPECIFICATIONS (CONTINUED)

Component/Function

Set values

Thermo-time switch 35 °C/ 8 s

* Internal electrical resistance between:	Below +30°C	Above +40°C
Terminal G and ground:	25...40 Ω	50... 80 Ω
Terminal W and ground:	0 Ω	100...160 Ω
Terminal G and terminal W:	25...40 Ω	50... 80 Ω

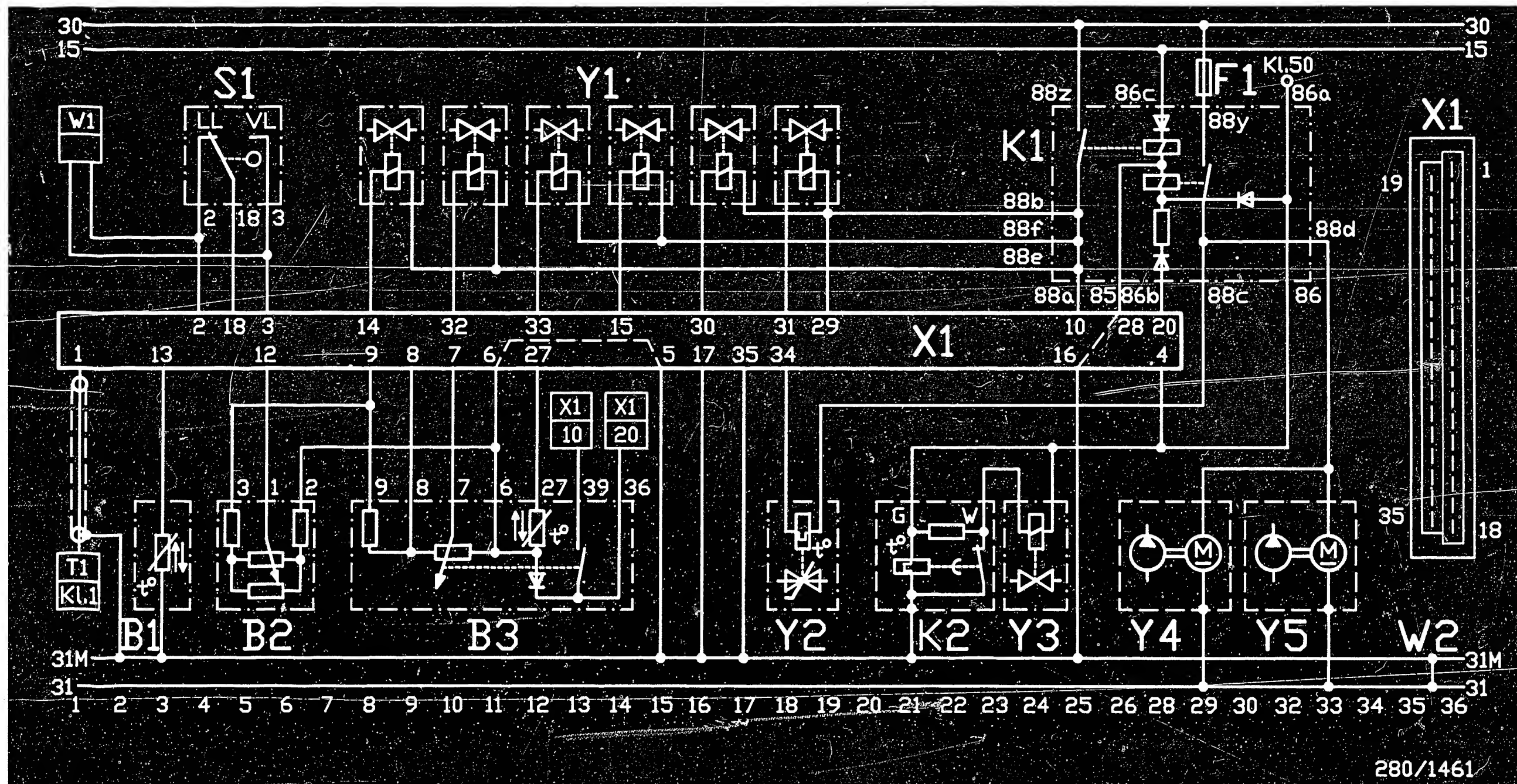
Cold-start valve

- * Internal electrical resistance: 3,5...4,5 Ω
- * Leakage, maximum permissible: 1 drops/min.

Idle adjustment

- * Idle speed
Manually shifted and automatic transmissions: 800...1000 min⁻¹
- * CO content: 0,5...0,7 % by vol.

For production reasons:
continued on the following
coordinate.



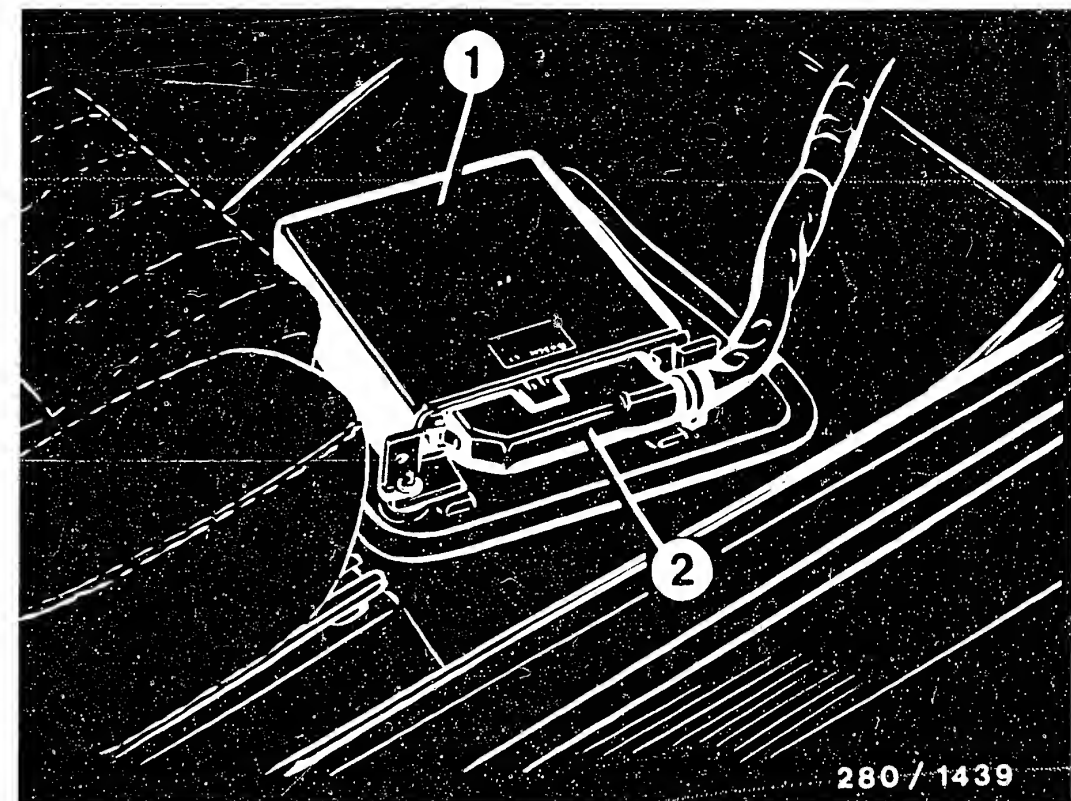
B1 = Temperature sensor (engine)
 B2 = Pressure sensor (altitude sensor)
 B3 = Air-flow sensor
 with pump contact
 F1 = Pump fuse
 K1 = Relay set

K2 = Thermo-time switch
 S1 = Throttle-valve switch
 T1 = From ignition coil
 W1 = To EI control unit
 W2 = Ground strap, engine
 X1 = Control-unit plug

Y1 = Solenoid-operated injection valves
 Y2 = Auxiliary-air device
 Y3 = Cold-start valve
 Y4 = Electric fuel pump
 Y5 = In-tank pre-supply pump

ELECTRICAL TERMINAL DIAGRAM

For production reasons:
continued on the following
coordinate.



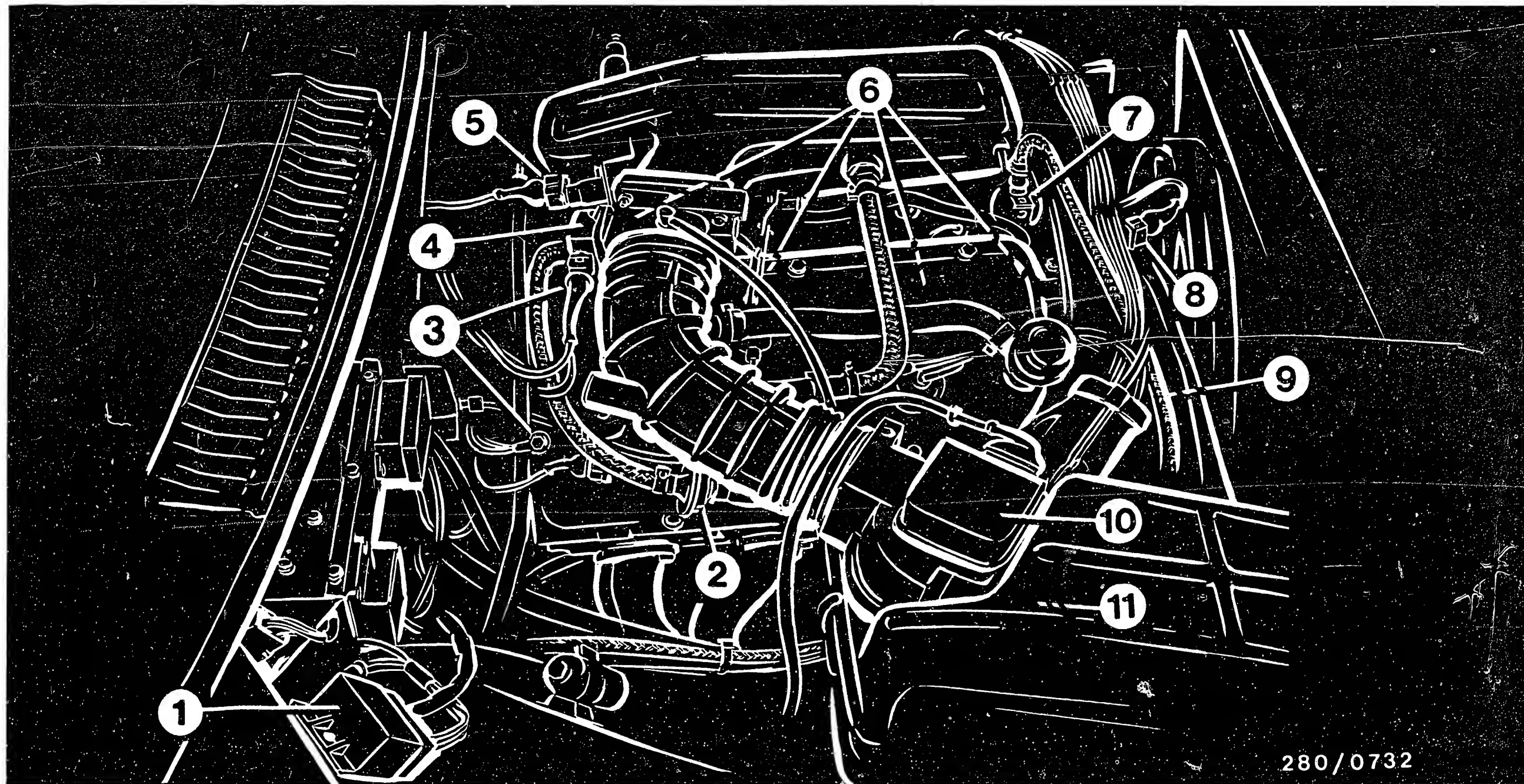
- 1 = Pressure-measuring connection
- 2 = Solenoid-operated injection valves
- 3 = Pressure regulator

FUEL-PRESSURE TEST

To test pressure, use pressure gauge and hose of pressure-measuring device KDJE-P 100.

Insert connecting piece KDJE-P 100/13 at fuel-distribution-pipe inlet and connect hose to pressure gauge at lateral threaded connector.

Caution. When opening the screw connection take care that no fuel comes into contact with hot engine parts.



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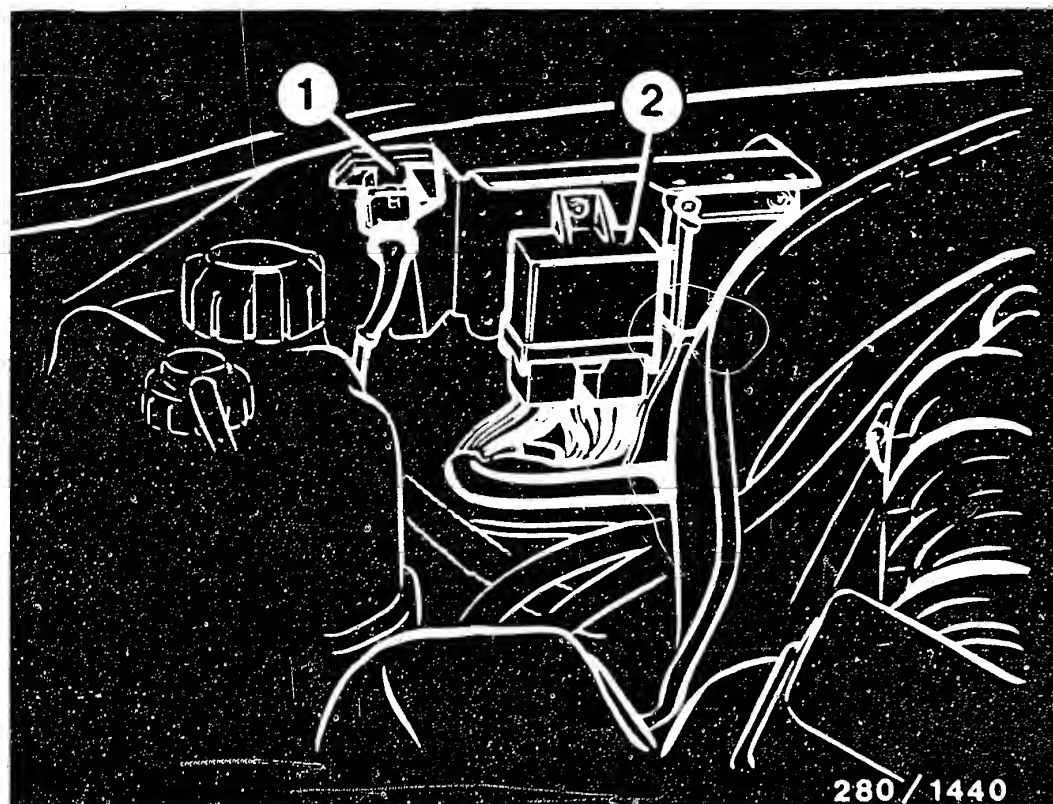
1 = Relay set
 2 = Auxiliary-air device
 3 = Central ground in GTV,
 at auxiliary-air device in 75

4 = Throttle-valve switch
 5 = Cold-start valve
 6 = Solenoid-operated injection valves
 7 = Pressure regulator

8 = Temperature sensor (engine)
 9 = Thermo-time switch
 10 = Air-flow sensor
 11 = Air filter

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

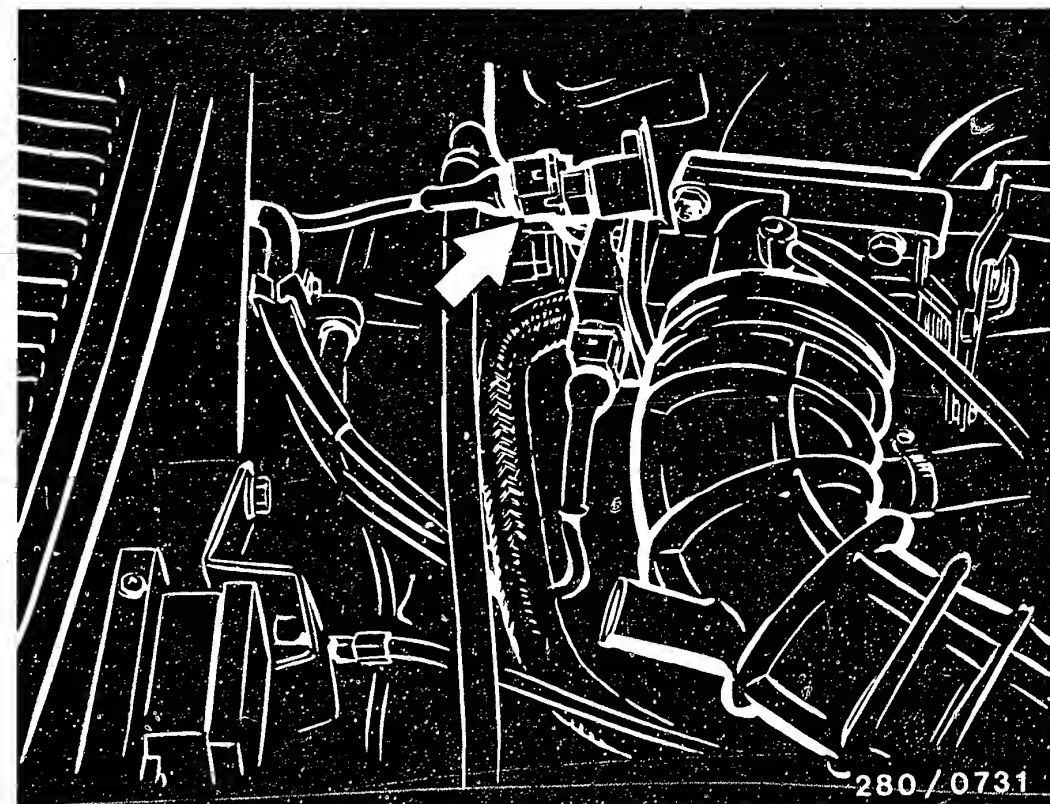
* Layout of components on the engine



- 1 = Pressure sensor (altitude sensor)
- 2 = Relay set
- 3 = Air-flow sensor

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Electric fuel pump on the vehicle floor in front of the rear axle.
- * In-tank pre-supply pump is accessible via a locking ring on the fuel tank.
- * Fuel filter on the vehicle floor in front of the rear axle.



Arrow = Cold-start valve

TESTING THE FUEL PRESSURE

Disconnect hose from the cold-start valve (arrow).

Connect pressure gauge.
Do not damage the cold-start valve when disconnecting and connecting the fuel pressure hose.

Make sure all connections are tight.